

IP Addressing and Subnetting

Workbook
Version 2.0

Instructor's Edition

IP Address Classes

| | | | |
|---------|---------------------|-------------------------------------------------------------|---------------------------------------------------------------------------|
| Class A | 1 – 127 | (Network 127 is reserved for loopback and internal testing) | |
| | Leading bit pattern | 0 | 00000000.00000000.00000000.00000000 Network . Host . Host . Host |
| Class B | 128 – 191 | Leading bit pattern | 10 |
| | | | 10000000.00000000.00000000.00000000 Network . Network . Host . Host |
| Class C | 192 – 223 | Leading bit pattern | 110 |
| | | | 11000000.00000000.00000000.00000000 Network . Network . Network . Host |
| Class D | 224 – 239 | (Reserved for multicast) | |
| Class E | 240 – 255 | (Reserved for experimental, used for research) | |

Private Address Space

| | |
|---------|--------------------------------|
| Class A | 10.0.0.0 to 10.255.255.255 |
| Class B | 172.16.0.0 to 172.31.255.255 |
| Class C | 192.168.0.0 to 192.168.255.255 |

Default Subnet Masks

| | |
|---------|---------------|
| Class A | 255.0.0.0 |
| Class B | 255.255.0.0 |
| Class C | 255.255.255.0 |

Produced by: Robb Jones
jonesr@careertech.net and/or Robert.Jones@fcps.org
Frederick County Career & Technology Center
Cisco Networking Academy
Frederick County Public Schools
Frederick, Maryland, USA

Special Thanks to Melvin Baker and Jim Dorsch
for taking the time to check this workbook for errors,
and to everyone who has sent in suggestions to improve the series.

Workbooks included in the series:

IP Addressing and Subnetting Workbooks
ACLs - Access Lists Workbooks
VLSM Variable-Length Subnet Mask Workbooks

Instructors (and anyone else for that matter) please do not post the Instructors version on public websites. When you do this you are giving everyone else worldwide the answers. Yes, students look for answers this way. It also discourages others; myself included, from posting high quality materials.

Binary To Decimal Conversion

| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | Answers | Scratch Area | |
|-----|----|----|----|---|---|---|----------|------------|--------------|-----|
| 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | <u>146</u> | 128 | 64 |
| 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | <u>119</u> | 16 | 32 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | <u>255</u> | 2 | 16 |
| 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | <u>197</u> | 146 | 4 |
| 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | <u>246</u> | | 2 |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | <u>19</u> | | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | <u>129</u> | | 119 |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | <u>49</u> | | |
| 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | <u>120</u> | | |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | <u>240</u> | | |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | <u>59</u> | | |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | <u>7</u> | | |
| | | | | | | | 00011011 | <u>27</u> | | |
| | | | | | | | 10101010 | <u>170</u> | | |
| | | | | | | | 01101111 | <u>111</u> | | |
| | | | | | | | 11111000 | <u>248</u> | | |
| | | | | | | | 00100000 | <u>32</u> | | |
| | | | | | | | 01010101 | <u>85</u> | | |
| | | | | | | | 00111110 | <u>62</u> | | |
| | | | | | | | 00000011 | <u>3</u> | | |
| | | | | | | | 11101101 | <u>237</u> | | |
| | | | | | | | 11000000 | <u>192</u> | | |

Decimal To Binary Conversion

Use all 8 bits for each problem

| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 = | 255 | Scratch Area | |
|-----|----|----|----|---|---|---|-----|-----|--------------|-----|
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 238 | 238 | 34 |
| 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 34 | -128 | -32 |
| 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 123 | 110 | 2 |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 50 | -64 | -2 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 255 | 46 | 0 |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 200 | -32 | |
| 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 10 | 14 | |
| 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 138 | -8 | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 6 | |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 13 | -4 | |
| 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 250 | 2 | |
| 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 107 | -2 | |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 224 | 0 | |
| 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 114 | | |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 192 | | |
| 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 172 | | |
| 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 100 | | |
| 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 119 | | |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 57 | | |
| 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 98 | | |
| 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 179 | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | | |

Address Class Identification

| Address | Class |
|---------------|----------|
| 10.250.1.1 | <u>A</u> |
| 150.10.15.0 | <u>B</u> |
| 192.14.2.0 | <u>C</u> |
| 148.17.9.1 | <u>B</u> |
| 193.42.1.1 | <u>C</u> |
| 126.8.156.0 | <u>A</u> |
| 220.200.23.1 | <u>C</u> |
| 230.230.45.58 | <u>D</u> |
| 177.100.18.4 | <u>B</u> |
| 119.18.45.0 | <u>A</u> |
| 249.240.80.78 | <u>E</u> |
| 199.155.77.56 | <u>C</u> |
| 117.89.56.45 | <u>A</u> |
| 215.45.45.0 | <u>C</u> |
| 199.200.15.0 | <u>C</u> |
| 95.0.21.90 | <u>A</u> |
| 33.0.0.0 | <u>A</u> |
| 158.98.80.0 | <u>B</u> |
| 219.21.56.0 | <u>C</u> |

Network & Host Identification

Circle the network portion of these addresses:

177.100.18.4

119.18.45.0

209.240.80.78

199.155.77.56

117.89.56.45

215.45.45.0

192.200.15.0

95.0.21.90

33.0.0.0

158.98.80.0

217.21.56.0

10.250.1.1

150.10.15.0

192.14.2.0

148.17.9.1

193.42.1.1

126.8.156.0

220.200.23.1

Circle the host portion of these addresses:

10.15.123.50

171.2.199.31

198.125.87.177

223.250.200.222

17.45.222.45

126.201.54.231

191.41.35.112

155.25.169.227

192.15.155.2

123.102.45.254

148.17.9.155

100.25.1.1

195.0.21.98

25.250.135.46

171.102.77.77

55.250.5.5

218.155.230.14

10.250.1.1

Network Addresses

Using the IP address and subnet mask shown write out the network address:

| | |
|---------------------------------|----------------------------|
| 188.10.18.2 255.255.0.0 | <u>188 . 10 . 0 . 0</u> |
| 10.10.48.80 255.255.255.0 | <u>10 . 10 . 48 . 0</u> |
| 192.149.24.191 255.255.255.0 | <u>192 . 149 . 24 . 0</u> |
| 150.203.23.19 255.255.0.0 | <u>150 . 203 . 0 . 0</u> |
| 10.10.10.10 255.0.0.0 | <u>10 . 0 . 0 . 0</u> |
| 186.13.23.110 255.255.255.0 | <u>186 . 13 . 23 . 0</u> |
| 223.69.230.250 255.255.0.0 | <u>223 . 69 . 0 . 0</u> |
| 200.120.135.15 255.255.255.0 | <u>200 . 120 . 135 . 0</u> |
| 27.125.200.151 255.0.0.0 | <u>27 . 0 . 0 . 0</u> |
| 199.20.150.35 255.255.255.0 | <u>199 . 20 . 150 . 0</u> |
| 191.55.165.135 255.255.255.0 | <u>191 . 55 . 165 . 0</u> |
| 28.212.250.254 255.255.0.0 | <u>28 . 212 . 0 . 0</u> |

Host Addresses

Using the IP address and subnet mask shown write out the host address:

| | |
|---------------------------------|-------------------------|
| 188.10.18.2 255.255.0.0 | <i>0 . 0 . 18 . 2</i> |
| 10.10.48.80 255.255.255.0 | <i>0 . 0 . 0 . 80</i> |
| 222.49.49.11 255.255.255.0 | <i>0 . 0 . 0 . 11</i> |
| 128.23.230.19 255.255.0.0 | <i>0 . 0 . 230 . 19</i> |
| 10.10.10.10 255.0.0.0 | <i>0 . 10 . 10 . 10</i> |
| 200.113.123.11 255.255.255.0 | <i>0 . 0 . 0 . 11</i> |
| 223.169.23.20 255.255.0.0 | <i>0 . 0 . 23 . 20</i> |
| 203.20.35.215 255.255.255.0 | <i>0 . 0 . 0 . 215</i> |
| 117.15.2.51 255.0.0.0 | <i>0 . 15 . 2 . 51</i> |
| 199.120.15.135 255.255.255.0 | <i>0 . 0 . 0 . 135</i> |
| 191.55.165.135 255.255.255.0 | <i>0 . 0 . 0 . 135</i> |
| 48.21.25.54 255.255.0.0 | <i>0 . 0 . 25 . 54</i> |

Default Subnet Masks

Write the correct default subnet mask for each of the following addresses:

| | |
|-----------------|----------------------------|
| 177.100.18.4 | <u>255 . 255 . 0 . 0</u> |
| 119.18.45.0 | <u>255 . 0 . 0 . 0</u> |
| 191.249.234.191 | <u>255 . 255 . 0 . 0</u> |
| 223.23.223.109 | <u>255 . 255 . 255 . 0</u> |
| 10.10.250.1 | <u>255 . 0 . 0 . 0</u> |
| 126.123.23.1 | <u>255 . 0 . 0 . 0</u> |
| 223.69.230.250 | <u>255 . 255 . 255 . 0</u> |
| 192.12.35.105 | <u>255 . 255 . 255 . 0</u> |
| 77.251.200.51 | <u>255 . 0 . 0 . 0</u> |
| 189.210.50.1 | <u>255 . 255 . 0 . 0</u> |
| 88.45.65.35 | <u>255 . 0 . 0 . 0</u> |
| 128.212.250.254 | <u>255 . 255 . 0 . 0</u> |
| 193.100.77.83 | <u>255 . 255 . 255 . 0</u> |
| 125.125.250.1 | <u>255 . 0 . 0 . 0</u> |
| 1.1.10.50 | <u>255 . 0 . 0 . 0</u> |
| 220.90.130.45 | <u>255 . 255 . 255 . 0</u> |
| 134.125.34.9 | <u>255 . 255 . 0 . 0</u> |
| 95.250.91.99 | <u>255 . 0 . 0 . 0</u> |

ANDING With Default subnet masks

Every IP address must be accompanied by a subnet mask. By now you should be able to look at an IP address and tell what class it is. Unfortunately your computer doesn't think that way. For your computer to determine the network and subnet portion of an IP address it must "AND" the IP address with the subnet mask.

Default Subnet Masks:

| | |
|---------|---------------|
| Class A | 255.0.0.0 |
| Class B | 255.255.0.0 |
| Class C | 255.255.255.0 |

ANDING Equations:

1 AND 1 = 1
 1 AND 0 = 0
 0 AND 1 = 0
 0 AND 0 = 0

Sample:

What you see...

IP Address: 192 . 100 . 10 . 33

What you can figure out in your head...

| | |
|------------------|----------------------------|
| Address Class: | C |
| Network Portion: | <u>192 . 100 . 10</u> . 33 |
| Host Portion: | 192 . 100 . 10 . <u>33</u> |

In order for your computer to get the same information it must AND the IP address with the subnet mask in binary.

| | Network | Host | |
|----------------------|-------------------------------------------------------|-----------------|-----------------------|
| IP Address: | 1 1 0 0 0 0 0 0 . 0 1 1 0 0 1 0 0 . 0 0 0 0 1 0 1 0 . | 0 0 1 0 0 0 0 1 | (192 . 100 . 10 . 33) |
| Default Subnet Mask: | 1 1 1 1 1 1 1 1 . 0 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . | 0 0 0 0 0 0 0 0 | (255 . 255 . 255 . 0) |
| AND: | 1 1 0 0 0 0 0 0 . 0 1 1 0 0 1 0 0 . 0 0 0 0 1 0 1 0 . | 0 0 0 0 0 0 0 0 | (192 . 100 . 10 . 0) |

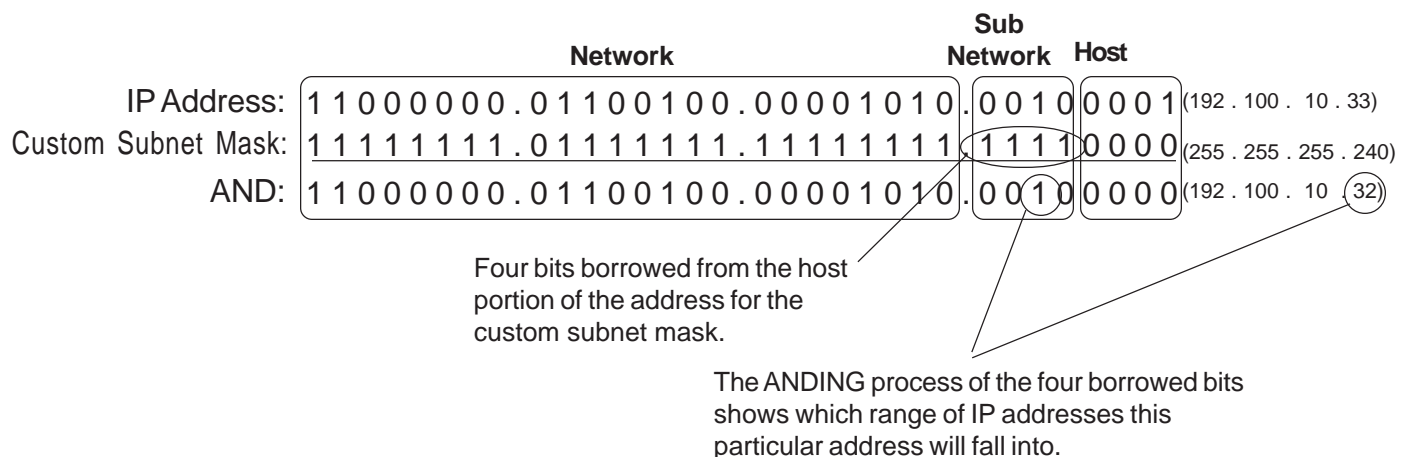
ANDING with the default subnet mask allows your computer to figure out the network portion of the address.

ANDING With Custom subnet masks

When you take a single network such as 192.100.10.0 and divide it into five smaller networks (192.100.10.16, 192.100.10.32, 192.100.10.48, 192.100.10.64, 192.100.10.80) the outside world still sees the network as 192.100.10.0, but the internal computers and routers see five smaller subnetworks. Each independent of the other. This can only be accomplished by using a custom subnet mask. A custom subnet mask borrows bits from the host portion of the address to create a subnetwork address between the network and host portions of an IP address. In this example each range has 14 usable addresses in it. The computer must still AND the IP address against the custom subnet mask to see what the network portion is and which subnetwork it belongs to.

IP Address: 192 . 100 . 10 . 0
Custom Subnet Mask: 255.255.255.240

Address Ranges: 192.10.10.0 to 192.100.10.15
 192.100.10.16 to 192.100.10.31
 192.100.10.32 to 192.100.10.47 (Range in the sample below)
 192.100.10.48 to 192.100.10.63
 192.100.10.64 to 192.100.10.79
 192.100.10.80 to 192.100.10.95
 192.100.10.96 to 192.100.10.111
 192.100.10.112 to 192.100.10.127
 192.100.10.128 to 192.100.10.143
 192.100.10.144 to 192.100.10.159
 192.100.10.160 to 192.100.10.175
 192.100.10.176 to 192.100.10.191
 192.100.10.192 to 192.100.10.207
 192.100.10.208 to 192.100.10.223
 192.100.10.224 to 192.100.10.239
 192.100.10.240 to 192.100.10.255



In the next set of problems you will determine the necessary information to determine the correct subnet mask for a variety of IP addresses.

How to determine the number of subnets and the number of hosts per subnet

Two formulas can provide this basic information:

Number of subnets = 2^s (Second subnet formula: **Number of subnets = $2^s - 2$**)

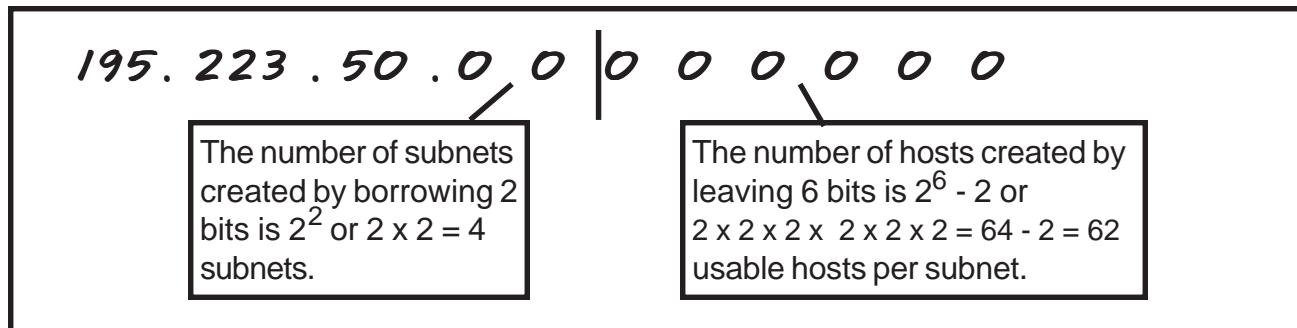
Number of hosts per subnet = $2^h - 2$

Both formulas calculate the number of hosts or subnets based on the number of binary bits used. For example if you borrow three bits from the host portion of the address use the *number of subnets* formula to determine the total number of subnets gained by borrowing the three bits. This would be 2^3 or $2 \times 2 \times 2 = 8$ subnets

To determine the number of hosts per subnet you would take the number of binary bits used in the host portion and apply this to the *number of hosts per subnet* formula. If five bits are in the host portion of the address this would be 2^5 or $2 \times 2 \times 2 \times 2 \times 2 = 32$ hosts.

When dealing with the *number of hosts per subnet* you have to subtract two addresses from the range. The first address in every range is the subnet number. The last address in every range is the broadcast address. These two addresses cannot be assigned to any device in the network which is why you have to subtract two addresses to find the number of usable addresses in each range.

For example if two bits are borrowed for the network portion of the address you can easily determine the number of subnets and hosts per subnets using the two formulas.



What about that second subnet formula:

Number of subnets = $2^s - 2$

In some instances the first and last subnet range of addresses are reserved. This is similar to the first and last host addresses in each range of addresses.

The first range of addresses is the **zero subnet**. The subnet number for the *zero subnet* is also the subnet number for the classful subnet address.

The last range of addresses is the **broadcast subnet**. The broadcast address for the last subnet in the *broadcast subnet* is the same as the classful broadcast address.

Class C Address unsubnetted:

195. 223 . 50 . 0

195.223.50.0 to 195.223.50.255

Class C Address subnetted (2 bits borrowed):

195. 223 . 50 . 0 0 | 0 0 0 0 0 0

(Invalid range) (0) 195.223.50.0 to 195.223.50.63
(1) 195.223.50.64 to 195.223.50.127
(2) 195.223.50.128 to 195.223.50.191
(Invalid range) (3) 195.223.50.192 to 195.223.50.255

Notice that the subnet and broadcast addresses match.

The primary reason the the zero and broadcast subnets were not used had to do primarily with the broadcast addresses. If you send a broadcast to 195.223.255 are you sending it to all 255 addresses in the classful C address or just the 62 usable addresses in the broadcast range?

The **CCNA** and **CCENT** certification exams may have questions which will require you to determine which formula to use, and whether or not you can use the first and last subnets. Use the chart below to help decide.

| When to use which formula to determine the number of subnets | |
|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Use the $2^S - 2$ formula and <u>don't use</u> the zero and broadcast ranges if... | Use the 2^S formula and <u>use</u> the zero and broadcast ranges if... |
| Classful routing is used | Classless routing or VLSM is used |
| RIP version 1 is used | RIP version 2, EIGRP, or OSPF is used |
| The no ip subnet zero command is configured on your router | The ip subnet zero command is configured on your router (default setting) |
| | No other clues are given |

Bottom line for the CCNA exams; if a question does not give you any clues as to whether or not to allow these two subnets, assume you can use them.

This workbook has you use the number of subnets = 2^S formula.

Custom Subnet Masks

Problem 1

Number of needed subnets **14**
 Number of needed usable hosts **14**
 Network Address **192.10.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 240

Total number of subnets 16

Total number of host addresses 16

Number of usable addresses 14

Number of bits borrowed 4

Show your work for Problem 1 in the space below.

| | | | | | | | | | | | |
|-------------------|---|-----|-----|----|----|----|----|-----|-----|---|-----------------|
| | | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | Number of Hosts |
| Number of Subnets | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | | |
| | | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - | Binary values |
| 192 . 10 . 10 . 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

Add the binary value numbers to the left of the line to create the custom subnet mask.

| | |
|--|-------|
| | 128 |
| | 64 |
| | 32 |
| | +16 |
| | <hr/> |
| | 240 |

| | |
|-------|--------------------------------------------|
| 16 | Observe the total number of hosts. |
| -2 | |
| <hr/> | |
| 14 | Subtract 2 for the number of usable hosts. |

Custom Subnet Masks

Problem 2

Number of needed subnets **1000**

Number of needed usable hosts **60**

Network Address **165.100.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

Show your work for **Problem 2** in the space below.

| | | | | | | | | | | | | | | | | |
|---------------------|--------|--------|--------|-------|-------|-------|-------|-----|-----|------|------|------|------|-------|-------|-------|
| Number of Hosts - | 65,536 | 32,768 | 16,384 | 8,192 | 4,096 | 2,048 | 1,024 | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| Number of Subnets - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4096 | 8192 | 16384 | 32768 | 65536 |
| Binary values - | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| | 165 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Add the binary value numbers to the left of the line to create the custom subnet mask.

| | |
|-----|-----|
| 128 | 128 |
| 64 | +64 |
| 32 | 192 |
| 16 | |
| 8 | |
| 4 | |
| 2 | |
| +1 | |
| 255 | |

Observe the total number of hosts.

Subtract 2 for the number of usable hosts.

| |
|----|
| 64 |
| -2 |
| 62 |

Custom Subnet Masks

Problem 3

Network Address **148.75.0.0 /26**

/26 indicates the total number of bits used for the network and subnetwork portion of the address. All bits remaining belong to the host portion of the address.

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

Show your work for **Problem 3** in the space below.

| | | | | | | | | | | | | | | | | |
|-------------------|--------|--------|--------|-------|-------|-------|-------|-----|-----|-----|------|------|------|------|-------|-------|
| | 65,536 | 32,768 | 16,384 | 8,192 | 4,096 | 2,048 | 1,024 | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| Number of Hosts | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Number of Subnets | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4096 | 8192 | 16384 | 32768 |
| Binary values | - | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| | | 148 | 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Add the binary value numbers to the left of the line to create the custom subnet mask.

| | |
|------------|-----|
| 128 | 128 |
| 64 | +64 |
| 32 | 192 |
| 16 | |
| 8 | |
| 4 | |
| 2 | |
| +1 | |
| <u>255</u> | |

| | |
|-----------|--------------------------------------------|
| 64 | Observe the total number of hosts. |
| -2 | |
| <u>62</u> | Subtract 2 for the number of usable hosts. |

| | |
|--------------|---------------------------------------------------------------------------------|
| 1024 | |
| -2 | |
| <u>1,022</u> | Subtract 2 for the total number of subnets to get the usable number of subnets. |

Custom Subnet Masks

Problem 4

Number of needed subnets **6**
 Number of needed usable hosts **30**
 Network Address **195.85.8.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

Show your work for Problem 5 in the space below.

| | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | - | Number of Hosts |
|-------------------|-----|-----|----|----|----|----|----|-----|-----|-----------------|
| Number of Subnets | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | |
| | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - | Binary values |
| 195 . 85 . 8 . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

| | | |
|-----|----|----|
| 128 | 32 | 8 |
| 64 | -2 | -2 |
| +32 | 30 | 6 |
| 224 | | |

Custom Subnet Masks

Problem 5

Number of needed subnets **6**
 Number of needed usable hosts **30**
 Network Address **210.100.56.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

Show your work for Problem 4 in the space below.

| | | | | | | | | | Number of | | | | |
|-------------------|--|--|--|-----|-----|----|----|----|-----------|----|-----|-----|---------------|
| | | | | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | Hosts |
| Number of Subnets | | | | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | |
| | | | | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - | Binary values |
| 210 . 100 . 56 . | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 128 | | | | | | | | | | | | | |
| 64 | | | | 8 | | | 32 | | | | | | |
| +32 | | | | -2 | | | -2 | | | | | | |
| 224 | | | | 6 | | | 30 | | | | | | |

Custom Subnet Masks

Problem 7

Number of needed subnets **2000**
 Number of needed usable hosts **15**
 Network Address **178.100.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 2,048

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 11

Show your work for Problem 7 in the space below.

| | | | | | | | | | | | | | | | | |
|-------------------|--------|--------|--------|-------|-------|-------|-------|-----|-----|------|------|-------|-------|--------|--------|--------|
| Number of Hosts | 65,536 | 32,768 | 16,384 | 8,192 | 4,096 | 2,048 | 1,024 | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| Number of Subnets | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4,096 | 8,192 | 16,384 | 32,768 | 65,536 |
| Binary values | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 178 . 100 . 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

$$\begin{array}{r}
 128 \\
 64 \\
 32 \\
 16 \\
 8 \\
 4 \\
 2 \\
 +1 \\
 \hline
 255
 \end{array}
 \qquad
 \begin{array}{r}
 2,048 \\
 -2 \\
 \hline
 2,046
 \end{array}
 \qquad
 \begin{array}{r}
 32 \\
 -2 \\
 \hline
 30
 \end{array}$$

Custom Subnet Masks

Problem 8

Number of needed subnets **3**

Number of needed usable hosts **45**

Network Address **200.175.14.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 4

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 2

Show your work for Problem 8 in the space below.

| | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | - | Number of Hosts |
|-------------------|-----|-----|----|----|----|----|----|-----|-----|-----------------|
| Number of Subnets | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | |
| | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - | Binary values |
| 200 . 175 . 14 . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

| | | |
|-----------|---------|----------|
| 128 | 4 | 64 |
| +64 | -2 | -2 |
| <hr/> 240 | <hr/> 2 | <hr/> 62 |

Custom Subnet Masks

Problem 9

Number of needed subnets **60**
 Number of needed usable hosts **1,000**
 Network Address **128.77.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 252 . 0

Total number of subnets 64

Total number of host addresses 1,024

Number of usable addresses 1,022

Number of bits borrowed 6

Show your work for Problem 9 in the space below.

| | | | | | | | | | | | | | | | | |
|-------------------|--------|--------|--------|-------|-------|-------|-------|-----|-----|-----|------|------|------|------|-------|-------|
| | 65,536 | 32,768 | 16,384 | 8,192 | 4,096 | 2,048 | 1,024 | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| Number of Hosts | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Number of Subnets | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4096 | 8192 | 16384 | 32768 |
| Binary values | - | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| | | 128 | 77 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

$$\begin{array}{r}
 128 \\
 64 \\
 32 \\
 16 \\
 8 \\
 +4 \\
 \hline
 252
 \end{array}
 \quad
 \begin{array}{r}
 64 \\
 -2 \\
 \hline
 62
 \end{array}
 \quad
 \begin{array}{r}
 1,024 \\
 -2 \\
 \hline
 1,022
 \end{array}$$

Custom Subnet Masks

Problem 10

Number of needed usable hosts **60**

Network Address **198.100.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 4

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 2

Show your work for Problem 10 in the space below.

| | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | Number of Hosts |
|-------------------|-----|-----|----|----|----|----|----|-----|-----|-----------------|
| Number of Subnets | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | |
| | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | | Binary values |
| 198 . 100 . 10 . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

| | | |
|-----|----|----|
| 128 | 64 | 4 |
| +64 | -2 | -2 |
| 192 | 62 | 2 |

Custom Subnet Masks

Problem 11

Number of needed subnets **250**

Network Address 101.0.0.0

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 0 . 0

Total number of subnets 256

Total number of host addresses 65,536

Number of usable addresses 65,534

Number of bits borrowed 8

Show your work for **Problem 11** in the space below.

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------|---|---|---|---|----|----|----|-----|-----|-----|------|------|------|------|-------|-------|-------|--------|--------|--------|---------|---------|---------|---------|----------|----------|----------|-----------|-----------|-----------|------------|------------|------------|------------|-------------|-------------|-------------|--------------|--------------|--------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|---------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|----------------------------------------------|--------------------------------------|
| Number of Hosts | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4096 | 8192 | 16384 | 32768 | 65536 | 131072 | 262144 | 524288 | 1048576 | 2097152 | 4194304 | 8388608 | 16777216 | 33554432 | 67108864 | 134217728 | 268435456 | 536870912 | 1073741824 | 2147483648 | 4294967296 | 8589934592 | 17179869184 | 34359738368 | 68719476736 | 137438953472 | 274877906944 | 549755813888 | 1099511627776 | 2199023255552 | 4398046511104 | 8796093022208 | 17592186044416 | 35184372088832 | 70368744177664 | 140737488355328 | 281474976710656 | 562949953421312 | 1125899906842624 | 2251799813685248 | 4503599627370496 | 9007199254740992 | 18014398509481984 | 36028797018963968 | 72057594037927936 | 144115188075855872 | 288230376151711744 | 576460752303423488 | 1152921504606846976 | 2305843009213693952 | 4611686018427387904 | 9223372036854775808 | 18446744073709551616 | 36893488147419103232 | 73786976294838206464 | 147573952589676412928 | 295147905179352825856 | 590295810358705651712 | 1180591620717411303424 | 2361183241434822606848 | 4722366482869645213696 | 9444732965739290427392 | 18889465931478580854784 | 37778931862957161709568 | 75557863725914323419136 | 151115727451828646838272 | 302231454903657293676544 | 604462909807314587353088 | 1208925819614629174706176 | 2417851639229258349412352 | 4835703278458516698824704 | 9671406556917033397649408 | 19342813113834066795298816 | 38685626227668133590597632 | 77371252455336267181195264 | 154742504910672534362390528 | 309485009821345068724781056 | 618970019642690137449562112 | 1237940039285380274899124224 | 2475880078570760549798248448 | 4951760157141521099596496896 | 9903520314283042199192993792 | 19807040628566084398385987584 | 39614081257132168796771975168 | 79228162514264337593543950336 | 158456325028528675187087900672 | 316912650057057350374175801344 | 633825300114114700748351602688 | 1267650600228229401496703205376 | 2535301200456458802993406410752 | 5070602400912917605986812821504 | 10141204801825835211973625643008 | 20282409603651670423947251286016 | 40564819207303340847894502572032 | 81129638414606681695789005144064 | 162259276829213363391578010288128 | 324518553658426726783156020576256 | 649037107316853453566312041152512 | 1298074214633706907132624082305024 | 2596148429267413814265248164610048 | 5192296858534827628530496329220096 | 10384593717069655257060992658440192 | 20769187434139310514121985316880384 | 41538374868278621028243970633760768 | 83076749736557242056487941267521536 | 166153499473114484112975882535043072 | 332306998946228968225951765070086144 | 664613997892457936451903530140172288 | 1329227995784915872903807060280344576 | 2658455991569831745807614120560689152 | 5316911983139663491615228241121378304 | 10633823966279326983230456482242756608 | 21267647932558653966460912964485513216 | 42535295865117307932921825928971026432 | 85070591730234615865843651857942052864 | 170141183460469231731687303715884105216 | 340282366920938463463374607431768210432 | 680564733841876926926749214863536420864 | 1361129467683753853853498429727072841728 | 2722258935367507707706996859454145683456 | 5444517870735015415413993718908291366912 | 10889035741470030830827987437816582733824 | 21778071482940061661655974875633165467648 | 43556142965880123323311949751266330935296 | 87112285931760246646623899502532661870592 | 174224571863520493293247799005065323541184 | 348449143727040986586495598010130647082368 | 696898287454081973172991196020261294164736 | 1393796574908163946345982392040522588329472 | 2787593149816327892691964784081045176658944 | 5575186299632655785383929568162090353317888 | 11150372599265311570767859136324180706635776 | 223007451985306231415357182726483614 |
|--------------------|---|---|---|---|----|----|----|-----|-----|-----|------|------|------|------|-------|-------|-------|--------|--------|--------|---------|---------|---------|---------|----------|----------|----------|-----------|-----------|-----------|------------|------------|------------|------------|-------------|-------------|-------------|--------------|--------------|--------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|---------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|----------------------------------------------|--------------------------------------|

Custom Subnet Masks

Problem 12

Number of needed subnets **5**

Network Address **218.35.50.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

Show your work for Problem 12 in the space below.

| | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | - | Number of Hosts |
|-------------------|-----|-----|----|----|----|----|----|-----|-----|-----------------|
| Number of Subnets | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | |
| | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - | Binary values |
| 218 . 35 . 50 . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

| | | |
|------------|-----------|----------|
| 128 | | |
| 64 | 64 | 4 |
| +32 | -2 | -2 |
| <u>224</u> | <u>62</u> | <u>2</u> |

Custom Subnet Masks

Problem 13

Number of needed usable hosts **25**

Network Address **218.35.50.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

Show your work for Problem 13 in the space below.

| | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | - | Number of Hosts |
|-------------------|-----|-----|----|----|----|----|----|-----|-----|-----------------|
| Number of Subnets | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | |
| | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - | Binary values |
| 218 . 35 . 50 . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

| | | |
|-----|----|----|
| 128 | | |
| 64 | 8 | 32 |
| +32 | -2 | -2 |
| 224 | 6 | 30 |

Custom Subnet Masks

Problem 14

Number of needed subnets **10**

Network Address **172.59.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 240 . 0

Total number of subnets 16

Total number of host addresses 4,096

Number of usable addresses 4,094

Number of bits borrowed 4

Show your work for Problem 14 in the space below.

| | | | | | | | | | | | | | | | | |
|-------------------|--------|--------|--------|-------|-------|-------|-------|-----|-----|------|------|------|-------|--------|--------|--------|
| Number of Hosts | 65,536 | 32,768 | 16,384 | 8,192 | 4,096 | 2,048 | 1,024 | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| Number of Subnets | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4096 | 8,192 | 16,384 | 32,768 | 65,536 |
| Binary values | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| | 172 | 59 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

$$\begin{array}{r}
 128 \\
 64 \\
 32 \\
 +16 \\
 \hline
 240
 \end{array}
 \qquad
 \begin{array}{r}
 16 \\
 -2 \\
 \hline
 14
 \end{array}
 \qquad
 \begin{array}{r}
 4,096 \\
 -2 \\
 \hline
 4,094
 \end{array}$$

Custom Subnet Masks

Problem 15

Number of needed usable hosts **50**

Network Address **172.59.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Total number of host addresses _____ **64**

Number of usable addresses 62

Number of bits borrowed 10

Show your work for Problem 15 in the space below.

| | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
|-------------------|-----|-----|----|----|----|----|----|-----|-----|-----|-----|------|------|------|------|-------|-------|
| Number of Hosts | - | | | | | | | | | | | | | | | | |
| Number of Subnets | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | | 512 | 1024 | 2048 | 4096 | 8192 | 16384 | 32768 |
| Binary values | - | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| | 172 | 59 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | |
|-------|-------|-------|-------|
| 128 | | | |
| 64 | | | |
| 32 | | | |
| 16 | | | |
| 8 | | | |
| 4 | | | |
| 2 | 128 | 64 | 1,024 |
| +1 | +64 | -2 | -2 |
| <hr/> | <hr/> | <hr/> | <hr/> |
| 255 | 192 | 62 | 1,022 |

Custom Subnet Masks

Problem 16

Number of needed usable hosts **29**

Network Address **23.0.0.0**

Address class **A**

Default subnet mask **255 . 0 . 0 . 0**

Custom subnet mask **255 . 255 . 255 . 224**

Total number of subnets **524,288**

Total number of host addresses **32**

Number of usable addresses **30**

Number of bits borrowed **19**

Show your work for Problem 16 in the space below.

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------|---|---|---|---|----|----|----|-----|-----|-----|------|------|------|------|-------|-------|-------|--------|--------|--------|---------|---------|---------|---------|----------|----------|----------|-----------|-----------|-----------|------------|------------|------------|------------|-------------|-------------|-------------|--------------|--------------|--------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|---------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|------------------------------------------|-----------------------------------------|-----------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|---------------------------------------------------|---------------------------------------------------|---------------------------------------------------|---------------------------------------------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------|
| Number of Hosts | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4096 | 8192 | 16384 | 32768 | 65536 | 131072 | 262144 | 524288 | 1048576 | 2097152 | 4194304 | 8388608 | 16777216 | 33554432 | 67108864 | 134217728 | 268435456 | 536870912 | 1073741824 | 2147483648 | 4294967296 | 8589934592 | 17179869184 | 34359738368 | 68719476736 | 137438953472 | 274877906944 | 549755813888 | 1099511627776 | 2199023255552 | 4398046511104 | 8796093022208 | 17592186044416 | 35184372088832 | 70368744177664 | 140737488355328 | 281474976710656 | 562949953421312 | 1125899906842624 | 2251799813685248 | 4503599627370496 | 9007199254740992 | 18014398509481984 | 36028797018963968 | 72057594037927936 | 144115188075855872 | 288230376151711744 | 576460752303423488 | 1152921504606846976 | 2305843009213693952 | 4611686018427387904 | 9223372036854775808 | 18446744073709551616 | 36893488147419103232 | 73786976294838206464 | 147573952589676412928 | 295147905179352825856 | 590295810358705651712 | 1180591620717411303424 | 2361183241434822606848 | 4722366482869645213696 | 9444732965739290427392 | 18889465931478580854784 | 37778931862957161709568 | 75557863725914323419136 | 151115727451828646838272 | 302231454903657293676544 | 604462909807314587353088 | 1208925819614629174706176 | 2417851639229258349412352 | 4835703278458516698824704 | 9671406556917033397649408 | 19342813113834066795298816 | 38685626227668133590597632 | 77371252455336267181195264 | 154742504910672534362390528 | 309485009821345068724781056 | 618970019642690137449562112 | 1237940039285380274899124224 | 2475880078570760549798248448 | 4951760157141521099596496896 | 9903520314283042199192993792 | 19807040628566084398385987584 | 39614081257132168796771975168 | 79228162514264337593543950336 | 158456325028528675187087900672 | 316912650057057350374175801344 | 633825300114114700748351602688 | 1267650600228229401496703205376 | 2535301200456458802993406410752 | 5070602400912917605986812821504 | 10141204801825835211973625643008 | 20282409603651670423947251286016 | 40564819207303340847894502572032 | 81129638414606681695789005144064 | 162259276829213363391578010288128 | 324518553658426726783156020576256 | 649037107316853453566312041152512 | 1298074214633706907132624082305024 | 2596148429267413814265248164610048 | 5192296858534827628530496329220096 | 10384593717069655257060992658440192 | 20769187434139310514121985316880384 | 41538374868278621028243970633760768 | 83076749736557242056487941267521536 | 166153499473114484112975882535043072 | 332306998946228968225951765070086144 | 664613997892457936451903530140172288 | 1329227995784915872903807060280344576 | 2658455991569831745807614120560689152 | 5316911983139663491615228241121378304 | 10633823966279326983230456482242756608 | 21267647932558653966460912964485513216 | 42535295865117307932921825928971026432 | 85070591730234615865843651857942052864 | 170141183460469231731687303715884105728 | 340282366920938463463374607431768211456 | 680564733841876926926749214863536422912 | 1361129467683753853853498429727072845824 | 272225893536750770770699685945414569152 | 544451787073501541541399371890829138304 | 1088903574147003083082798743781658276608 | 2177807148294006166165597487563316553216 | 4355614296588012332331194975126633106432 | 8711228593176024664662389950253266212864 | 17422457186352049329324779900506532425728 | 34844914372704098658649559801013064851456 | 69689828745408197317299119602026129702912 | 139379657490816394634598239204052259405824 | 278759314981632789269196478408104518811648 | 557518629963265578538392956816209037623296 | 1115037259926531157076785913632418075246592 | 2230074519853062314153571827264836150493184 | 4460149039706124628307143654529672300986368 | 8920298079412249256614287309059344601972736 | 17840596158824498513228574618118689203945472 | 35681192317648997026457149236237378407890848 | 71362384635297994052914298472474756815781696 | 142724769270595988105828596944949513631563392 | 285449538541191976211657193889899027263126784 | 570899077082383952423314387779798054526253568 | 1141798154164767904846628775559596109052507136 | 2283596308329535809693257551119192218105014272 | 4567192616659071619386515102238384436210028544 | 9134385233318143238773030204476768872420057088 | 18268770466636286477546060408953537744840114176 | 36537540933272572955092120817907075489680228352 | 73075081866545145910184241635814150979360456704 | 146150163733090291820368483271628301958720913408 | 292300327466180583640736966543256603917441826816 | 584600654932361167281473933086513207834883653632 | 1169201309864722334562947866173026415669767307264 | 2338402619729444669125895732346052831339534614528 | 4676805239458889338251791464692105662679069229056 | 9353610478917778676503582929384211325358138458112 | 18707220957835557353007165858768422650716276916224 | 37414441915671114706014331717536845301432553832448 | 74828883831342229412028663435073690602865107664896 | 149657767662684458824057326870147381205730215329792 | 299315535325368917648114653740294762411460430659584 | 598631070650737835296229307480589524822920861319168 | 1197262141301475670592458614961179049645841722638336 | 2394524282602951341184917229922358099291683445276672 | 4789048565205902682369834459844716198583366890553344 | 9578097130411805364739668919689432397166733781106688 | 19156194260823610729479337839378864794333467562213376 | 38312388521647221458958675678757729588666935124426752 | 76624777043294442917917351357515459177333870248853504 | 153249554086588885835834702715030918354667740497707008 | 306499108173177771671669405430061836709335480995414016 | 612998216346355543343338810860123673418670961990828032 | 1225996432692711086686677621720247346837341923981665664 | 2451992865385422173373355243440494693674683847963331296 | 4903985730770844346746710486880989387349367695926662592 | 9807971461541688693493420973761978774698735391853325184 | 19615942923083377386986841947523957549397470783706650368 | 39231885846166754773973683895047915098794941567413300736 | 78463771692333509547947367790095830197589883134826601472 | 156927543384667019095894735580191660395179766269653202944 | 313855086769334038191789471160383320790359532539306405888 | 627710173538668076383578942320766641580719065078612811776 | 1255420347077336152767157884641533283161438130157225623552 | 2510840694154672305534315769283066566322876260314451247104 | 5021681388309344611068631538566133132645752520628902494208 | 10043362776618689222137263077132266265291505041257804988416 | 20086725553237378444274526154264532530583010082515609968256 | 40173451106474756888549052308529065061166020165031219936512 | 80346902212949513777098104617058130122332040330062439873024 | 160693804425899027554196209234116260244664080660124879746048 | 321387608851798055108392418468232520489328161320249759492096 | 642775217703596110216784836936465040978656322640499518984192 | 1285550435407192220433569673872930081957312645280999037968384 | 2571100870814384440867139347745860163914625290561998075936768 | 5142201741628768881734278695491720327829250581123996151873536 | 10284403483257537763468557390983440655658501162247992303747072 | 20568806966515075526937114781966881311317002324495984607494144 | 41137613933030151053874229563933762622634004648991969214988288 | 82275227866060302107748459127867525245268009297983938429976576 | 164550455732120604215496918255735050490536018595967876859953152 | 329100911464241208430993836511470100981072037191935753719906304 | 658201822928482416861987673022940201962144074383871507439812608 | 1316403645856964833723975346045880403924288148767743014879625216 | 2632807291713929667447950692091760807848576297535486029759250432 | 5265614583427859334895901384183521615697152595070972059518500864 | 10531229166855718669791802768367043231394305190141944119037001728 | 21062458333711437339583605536734086462788610380283888238074003456 | 42124916667422874679167211073468172925577220760567776476148006912 | 84249833334845749358334422146936345851154441521135552952296013824 | 168499666669691498716668844293872691702308883042271110904592027648 | 336999333339382997433337688587745383404617766084542221809184055296 | 673998666678765994866675377175490766809235532169084443618368110592 | 1347997333357531989733350754350981533618471064338168887236736221184 | 2695994666715063979466701508701963067236942128676337774473472442368 | 5391989333430127958933403017403926134473884257352675548946944884736 | 10783978666860255917866806034807852268947768514705351097893889689472 | 21567957333720511835733612069615704537895537029410702195787779378944 | 43135914667441023671467224139231409075791074058821404391575558757888 | 86271829334882047342934448278462818151582148117642808783151117515776 | 172543658669764094685868896556925636303164296235285617566302235031552 | 345087317339528189371737793113851272606328592470571235132604470063104 | 690174634679056378743475586227702545212657184941142470265208940126208 | 1380349269358112757486951172455405090425314369882284940530417880252416 | 2760698538716225514973902344910810180850628739764569881060835760504832 | 5521397077432451029947804689821620361701257479529139762121671521009664 | 11042794154864902059895609379643240723402514959058279524243343042019328 | 22085588309729804119791218759286481446805029918116559048486686084038656 | 44171176619459608239582437518572962893610059836233118096973372168077312 | 88342353238919216479164875037145925787220119672466236193946744336154624 | 176684706477838432958329750074291851574440239344932472387893488672309248 | 353369412955676865916659500148583703148880478689864944775786977344618496 | 706738825911353731833319000297167406297760957379729889551573954689236992 | 1413477651822707463666638000594334812595521914759459779103147909378473984 | 2826955303645414927333276001188669625191043829518919558206295818756947968 | 5653910607290829854666552002377339250382087659037839116412591637513895936 | 11307821214581659709333104004754678500764175318075678232825183275027791872 | 22615642429163319418666208009509357001528350636151356465650366550055583744 | 45231284858326638837332416019018714003056701272302712931300733100111167488 | 90462569716653277674664832038037428006113402544605425862601466200222334976 | 180925139433306555349329664076074856012226805089210851725202932400444669952 | 361850278866613110698659328152149712024453610178421703450405864800889339904 | 723700557733226221397318656304299424048907220356843406900811729601778679808 | 1447401115466452442794637312608598848097814440713686813801623459203557359616 | 2894802230932904885589274625217197696195628881427373627603246918407114719232 | 5789604461865809771178549250434395392391257762854747255206493836814229438464 | 11579208923731619542357098500868790784782515525709494510412987673628458876928 | 23158417847463239084714197001737581569565031051418989020825975347256917753856 | 46316835694926478169428394003475163139130062102837978041651950694513835507712 | 92633671389852956338856788006950326278260124205675956083303901389027671015424 | 185267342779705912677713576013900652556520248411351912166607802778055342030848 | 370534685559411825355427152027801305113040496822703824333215605556110684061696 | 741069371118823650710854304055602610226080993645407648666431211112221368123392 | 1482138742237647301421 |
|-----------------|---|---|---|---|----|----|----|-----|-----|-----|------|------|------|------|-------|-------|-------|--------|--------|--------|---------|---------|---------|---------|----------|----------|----------|-----------|-----------|-----------|------------|------------|------------|------------|-------------|-------------|-------------|--------------|--------------|--------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|---------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|------------------------------------------|-----------------------------------------|-----------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------------------|---------------------------------------------------|---------------------------------------------------|---------------------------------------------------|---------------------------------------------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------|

Subnetting

Problem 1

Number of needed subnets **14**

Number of needed usable hosts **14**

Network Address **192.10.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 240

Total number of subnets 16

Total number of host addresses 16

Number of usable addresses 14

Number of bits borrowed 4

What is the 4th subnet range? 192.10.10.48 to 192.10.10.63

What is the subnet number for the 8th subnet? 192 . 10 . 10 . 112

What is the subnet broadcast address for the 13th subnet? 192 . 10 . 10 . 207

What are the assignable addresses for the 9th subnet? 192.10.10.129 to 192.10.10.142

Show your work for Problem 1 in the space below.

| Number of Subnets | 256 128 64 32 | | | | 16 8 4 2 | | | | Number of Hosts | | |
|------------------------|---------------|----|----|----|---------------|----|-----|-----|--------------------|---------------|--|
| | - 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | | | |
| | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | Binary values | | |
| 192. 10 . 10 . 0 0 0 0 | | | | | 0 0 0 0 | | | | | | |
| <hr/> | | | | | | | | | | | |
| (1) | 0 | 0 | 0 | 0 | 192.10.10.0 | | | | to | 192.10.10.15 | |
| (2) | 0 | 0 | 0 | 1 | 192.10.10.16 | | | | to | 192.10.10.31 | |
| (3) | 0 | 0 | 1 | 0 | 192.10.10.32 | | | | to | 192.10.10.47 | |
| (4) | 0 | 0 | 1 | 1 | 192.10.10.48 | | | | to | 192.10.10.63 | |
| (5) | 0 | 1 | 0 | 0 | 192.10.10.64 | | | | to | 192.10.10.79 | |
| (6) | 0 | 1 | 0 | 1 | 192.10.10.80 | | | | to | 192.10.10.95 | |
| (7) | 0 | 1 | 1 | 0 | 192.10.10.96 | | | | to | 192.10.10.111 | |
| (8) | 0 | 1 | 1 | 1 | 192.10.10.112 | | | | to | 192.10.10.127 | |
| (9) | 1 | 0 | 0 | 0 | 192.10.10.128 | | | | to | 192.10.10.143 | |
| (10) | 1 | 0 | 0 | 1 | 192.10.10.144 | | | | to | 192.10.10.159 | |
| (11) | 1 | 0 | 1 | 0 | 192.10.10.160 | | | | to | 192.10.10.175 | |
| (12) | 1 | 0 | 1 | 1 | 192.10.10.176 | | | | to | 192.10.10.191 | |
| (13) | 1 | 1 | 0 | 0 | 192.10.10.192 | | | | to | 192.10.10.207 | |
| (14) | 1 | 1 | 0 | 1 | 192.10.10.208 | | | | to | 192.10.10.223 | |
| (15) | 1 | 1 | 1 | 0 | 192.10.10.224 | | | | to | 192.10.10.239 | |
| (16) | 1 | 1 | 1 | 1 | 192.10.10.240 | | | | to | 192.10.10.255 | |

$$\begin{array}{r}
 128 \\
 64 \\
 32 \\
 +16 \\
 \hline
 \text{Custom subnet mask } 240
 \end{array}$$

$$\begin{array}{r}
 16 \\
 -2 \\
 \hline
 \text{Usable subnets } 14
 \end{array}$$

$$\begin{array}{r}
 16 \\
 -2 \\
 \hline
 \text{Usable hosts } 14
 \end{array}$$

The binary value of the last bit borrowed is the range. In this problem the range is 16.

The first address in each subnet range is the subnet number.

The last address in each subnet range is the subnet broadcast address.

Subnetting

Problem 2

Number of needed subnets **1000**

Number of needed usable hosts **60**

Network Address **165.100.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

What is the 15th
subnet range? 165.100.3.128 to 165.100.3.191

What is the subnet number
for the 6th subnet? 165 . 100 . 1 . 64

What is the subnet
broadcast address for
the 6th subnet? 165 . 100 . 1 . 127

What are the assignable
addresses for the 9th
subnet? 165.100.2.1 to 165.100.0.62

Show your work for Problem 2 in the space below.

| | | | | | | | | | | | | | | | | |
|---------------------|--------|--------|--------|-------|-------|-------|-------|-------|--------|--------|--------|---------|---------|---------|-----------|-----------|
| Number of Hosts - | 65,536 | 32,768 | 16,384 | 8,192 | 4,096 | 2,048 | 1,024 | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| Number of Subnets - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1,024 | 2,048 | 4,096 | 8,192 | 16,384 | 32,768 | 65,536 |
| Binary values - | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 165.100.0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Usable hosts | 64 | 128 | 256 | 512 | 1,024 | 2,048 | 4,096 | 8,192 | 16,384 | 32,768 | 65,536 | 131,072 | 262,144 | 524,288 | 1,048,576 | 2,097,152 |
| Custom subnet mask | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 192 + 1 | 192 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 255 | 255 | 255 | 255 | 255 | 255 | 255 | 255 | 255 | 255 | 255 | 255 | 255 | 255 | 255 | 255 | 255 |

The binary value of the last bit borrowed is the range. In this problem the range is 64.

The first address in each subnet range is the subnet number.

The last address in each subnet range is the subnet broadcast address.

Down to

| | | | | | | | | | | | | | |
|--------|---|---|---|---|---|---|---|---|---|---|-----------------|----|-----------------|
| (1023) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 165.100.255.128 | to | 165.100.255.191 |
| (1024) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 165.100.255.192 | to | 165.100.255.255 |

Subnetting

Problem 3

Hint: It is possible to borrow one bit to create two subnets.

Number of needed subnets **2**

Network Address **195.223.50.0**

Address class **C**

Default subnet mask **255 . 255 . 255 . 0**

Custom subnet mask **255 . 255 . 255 . 128**

Total number of subnets **2**

Total number of host addresses **128**

Number of usable addresses **126**

Number of bits borrowed **1**

What is the 2nd subnet range? **195.223.50.128 - 195.223.50.255**

What is the subnet number for the 2nd subnet? **195.223.50.128**

What is the subnet broadcast address for the 1st subnet? **195.223.50.127**

What are the assignable addresses for the 1st subnet? **195.223.50.1 - 195.223.50.126**

Show your work for Problem 3 in the space below.

| | | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | - | Number of Hosts |
|--------------------------|---|-----|----------------------------------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Number of Subnets | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | | |
| | | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - | Binary values |
| 195. 223 . 50 . 0 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| (1) | | 0 | 195.223.50.0 to 195.223.50.127 | | | | | | | | |
| (2) | | 1 | 195.223.50.128 to 195.223.50.255 | | | | | | | | |

Subnetting

Problem 4

Number of needed subnets **750**

Network Address **190.35.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

What is the 15th subnet range? 190.35.3.128 to 190.35.3.191

What is the subnet number for the 13th subnet? 190.35.3.0

What is the subnet broadcast address for the 10th subnet? 190.35.2.127

What are the assignable addresses for the 6th subnet? 190.35.1.65 to 190.35.1.126

Show your work for **Problem 4** in the space below.

| | | | | | | | | | | | | | | | | |
|---------------------|--------|--------|--------|-------|-------|-------|-------|-----|-----|------|------|------|------|-------|-------|-------|
| Number of Hosts - | 65,536 | 32,768 | 16,384 | 8,192 | 4,096 | 2,048 | 1,024 | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| Number of Subnets - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4096 | 8192 | 16384 | 32768 | 65536 |
| Binary values - | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 190.35.0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (1) | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| (2) | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 |
| (3) | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 | 1 |
| (4) | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 | 1 | 1 |
| (5) | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 | 1 | 1 | 1 |
| (6) | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| (7) | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| (8) | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| (9) | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| (10) | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 |
| (11) | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 | 1 |
| (12) | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 | 1 | 1 |
| (13) | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 | 1 | 1 | 1 |
| (14) | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| (15) | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| (16) | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 190.35.0.63 | 190 | 35 | 0 | 63 | to | | | | | | | | | | | |
| 190.35.0.127 | 190 | 35 | 0 | 127 | to | | | | | | | | | | | |
| 190.35.0.191 | 190 | 35 | 0 | 191 | to | | | | | | | | | | | |
| 190.35.0.255 | 190 | 35 | 0 | 255 | to | | | | | | | | | | | |
| 190.35.1.63 | 190 | 35 | 1 | 63 | to | | | | | | | | | | | |
| 190.35.1.127 | 190 | 35 | 1 | 127 | to | | | | | | | | | | | |
| 190.35.1.191 | 190 | 35 | 1 | 191 | to | | | | | | | | | | | |
| 190.35.1.255 | 190 | 35 | 1 | 255 | to | | | | | | | | | | | |
| 190.35.2.63 | 190 | 35 | 2 | 63 | to | | | | | | | | | | | |
| 190.35.2.127 | 190 | 35 | 2 | 127 | to | | | | | | | | | | | |
| 190.35.2.191 | 190 | 35 | 2 | 191 | to | | | | | | | | | | | |
| 190.35.2.255 | 190 | 35 | 2 | 255 | to | | | | | | | | | | | |
| 190.35.3.63 | 190 | 35 | 3 | 63 | to | | | | | | | | | | | |
| 190.35.3.127 | 190 | 35 | 3 | 127 | to | | | | | | | | | | | |
| 190.35.3.191 | 190 | 35 | 3 | 191 | to | | | | | | | | | | | |
| 190.35.3.255 | 190 | 35 | 3 | 255 | to | | | | | | | | | | | |

Subnetting

Problem 5

Number of needed usable hosts **6**

Network Address **126.0.0.0**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 248

Total number of subnets 2,097,152

Total number of host addresses 8

Number of usable addresses 6

Number of bits borrowed 21

What is the 2nd subnet range? 126.0.0.8 to 126.0.0.15

What is the subnet number for the 5th subnet? 126.0.0.32

What is the subnet broadcast address for the 7th subnet? 126.0.0.55

What are the assignable addresses for the 10th subnet? 126.0.0.73 to 126.0.0.78

Show your work for Problem 5 in the space below.

[illegible]

Subnetting

Problem 6

Number of needed subnets **10**

Network Address **192.70.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 240

Total number of subnets 16

Total number of host addresses 16

Number of usable addresses 14

Number of bits borrowed 4

What is the 9th subnet range? 192.70.10.128 to 192.70.10.143

What is the subnet number for the 4th subnet? 192.70.10.48

What is the subnet broadcast address for the 12th subnet? 192.70.10.191

What are the assignable addresses for the 10th subnet? 192.70.10.145 to 192.70.10.158

Show your work for Problem 6 in the space below.

| | | 256 128 64 32 | | | | 16 8 4 2 - | | | | Number of Hosts |
|-------------------|---|---------------|----|----|----|---------------|----|----|-----|------------------|
| Number of Subnets | | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 |
| | | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - Binary values |
| 192 . 70 . 10 . | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| (1) | | | | | 0 | 192.70.10.0 | | | | to 192.70.10.15 |
| (2) | | | | | 1 | 192.70.10.16 | | | | to 192.70.10.31 |
| (3) | | | | 1 | 0 | 192.70.10.32 | | | | to 192.70.10.47 |
| (4) | | | | 1 | 1 | 192.70.10.48 | | | | to 192.70.10.63 |
| (5) | | | 1 | 0 | 0 | 192.70.10.64 | | | | to 192.70.10.79 |
| (6) | | | 1 | 0 | 1 | 192.70.10.80 | | | | to 192.70.10.95 |
| (7) | | | 1 | 1 | 0 | 192.70.10.96 | | | | to 192.70.10.111 |
| (8) | | | 1 | 1 | 1 | 192.70.10.112 | | | | to 192.70.10.127 |
| (9) | 1 | 0 | 0 | 0 | | 192.70.10.128 | | | | to 192.70.10.143 |
| (10) | 1 | 0 | 0 | 1 | | 192.70.10.144 | | | | to 192.70.10.159 |
| (11) | 1 | 0 | 1 | 0 | | 192.70.10.160 | | | | to 192.70.10.175 |
| (12) | 1 | 0 | 1 | 1 | | 192.70.10.176 | | | | to 192.70.10.191 |
| (13) | 1 | 1 | 0 | 0 | | 192.70.10.192 | | | | to 192.70.10.207 |
| (14) | 1 | 1 | 0 | 1 | | 192.70.10.208 | | | | to 192.70.10.223 |
| (15) | 1 | 1 | 1 | 0 | | 192.70.10.224 | | | | to 192.70.10.239 |
| (16) | 1 | 1 | 1 | 1 | | 192.70.10.240 | | | | to 192.70.10.255 |

$$\begin{array}{r}
 128 \\
 +64 \\
 \hline
 240
 \end{array}
 \qquad
 \begin{array}{r}
 16 \\
 -2 \\
 \hline
 14
 \end{array}$$

Subnetting

Problem 7

Network Address **10.0.0.0 /16**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 0 . 0

Total number of subnets 256

Total number of host addresses 65,536

Number of usable addresses 65,534

Number of bits borrowed 8

What is the 11th subnet range? 10.10.0.0 to 10.10.255.255

What is the subnet number for the 6th subnet? 10.5.0.0

What is the subnet broadcast address for the 2nd subnet? 10.1.255.255

What are the assignable addresses for the 9th subnet? 10.8.0.1 to 10.8.255.254

Show your work for **Problem 7** in the space below.

| | | | | | | | |
|-------------------|--------|-----|-----|-----|-----|-----|-----|
| Number of Hosts | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| Number of Subnets | 2 | 4 | 8 | 16 | 32 | 64 | 128 |
| Binary values | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| | 10 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| | 32 | 16 | 8 | 4 | 2 | 1 | 0 |
| | 16 | 8 | 4 | 2 | 1 | 0 | 0 |
| | 8 | 4 | 2 | 1 | 0 | 0 | 0 |
| | 4 | 2 | 1 | 0 | 0 | 0 | 0 |
| | 2 | 1 | 0 | 0 | 0 | 0 | 0 |
| | +1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 255 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 65,536 | 2 | 4 | 8 | 16 | 32 | 64 |
| | -2 | 1 | 2 | 4 | 8 | 16 | 32 |
| | 65,534 | 0 | 0 | 0 | 0 | 0 | 0 |

Subnetting

Problem 8

Number of needed subnets **5**

Network Address **172.50.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 224 . 0

Total number of subnets 8

Total number of host addresses 8,192

Number of usable addresses 8,190

Number of bits borrowed 3

What is the 4th subnet range? 172.50.96.0 to 172.50.127.255

What is the subnet number for the 5th subnet? 172.50.128.0

What is the subnet broadcast address for the 6th subnet? 172.50.191.255

What are the assignable addresses for the 3rd subnet? 172.50.64.1 to 172.50.95.254

Show your work for Problem 8 in the space below.

[illegible]

Subnetting

Problem 9

Number of needed usable hosts **28**

Network Address **172.50.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 2,048

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 11

What is the 2nd subnet range? 172.50.0.32 to 172.50.0.63

What is the subnet number for the 10th subnet? 172.50.1.32

What is the subnet broadcast address for the 4th subnet? 172.50.0.127

What are the assignable addresses for the 6th subnet? 172.50.0.161 to 172.50.0.190

Show your work for Problem 9 in the space below.

[illegible]

Subnetting

Problem 10

Number of needed subnets **45**

Network Address **220.100.100.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 252

Total number of subnets 64

Total number of host addresses 4

Number of usable addresses 2

Number of bits borrowed 6

What is the 5th subnet range? 220.100.100.16 to 220.100.100.19

What is the subnet number for the 4th subnet? 220.100.100.12

What is the subnet broadcast address for the 13th subnet? 220.100.100.51

What are the assignable addresses for the 12th subnet? 220.100.100.45 to 220.100.100.46

Show your work for Problem 10 in the space below.

| Number of Subnets | | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | - | Number of Hosts |
|-------------------|--|------|-----|----|----|----|----|----------------|-----|----------------|-----------------|
| - | | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | | |
| 128 | | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - | Binary values | |
| 220 . 100 . 100 . | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | (1) | | | | | 0 | 220.100.100.0 | to | 220.100.100.3 | |
| | | (2) | | | | | 1 | 220.100.100.4 | to | 220.100.100.7 | |
| | | (3) | | | | 1 | 0 | 220.100.100.8 | to | 220.100.100.11 | |
| | | (4) | | | | 1 | 1 | 220.100.100.12 | to | 220.100.100.15 | |
| | | (5) | | | 1 | 0 | 0 | 220.100.100.16 | to | 220.100.100.19 | |
| | | (6) | | | 1 | 0 | 1 | 220.100.100.20 | to | 220.100.100.23 | |
| | | (7) | | | 1 | 1 | 0 | 220.100.100.24 | to | 220.100.100.27 | |
| | | (8) | | | 1 | 1 | 1 | 220.100.100.28 | to | 220.100.100.31 | |
| | | (9) | 1 | | 0 | 0 | 0 | 220.100.100.32 | to | 220.100.100.35 | |
| | | (10) | 1 | | 0 | 0 | 1 | 220.100.100.36 | to | 220.100.100.39 | |
| | | (11) | 1 | | 0 | 1 | 0 | 220.100.100.40 | to | 220.100.100.43 | |
| | | (12) | 1 | | 0 | 1 | 1 | 220.100.100.44 | to | 220.100.100.47 | |
| | | (13) | 1 | | 1 | 0 | 0 | 220.100.100.48 | to | 220.100.100.51 | |
| | | (14) | 1 | | 1 | 0 | 1 | 220.100.100.52 | to | 220.100.100.55 | |
| | | (15) | 1 | | 1 | 1 | 0 | 220.100.100.56 | to | 220.100.100.59 | |
| | | (16) | 1 | | 1 | 1 | 1 | 220.100.100.60 | to | 220.100.100.63 | |

128
64
32
16
8
+4
252

4
-2
2

Subnetting

Problem 11

Number of needed usable hosts **8,000**

Network Address **135.70.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 224 . 0

Total number of subnets 8

Total number of host addresses 8,192

Number of usable addresses 8,190

Number of bits borrowed 3

What is the 6th subnet range? 135.70.160.0 to 135.70.191.255

What is the subnet number for the 7th subnet? 135.70.192.0

What is the subnet broadcast address for the 3rd subnet? 135.70.95.255

What are the assignable addresses for the 5th subnet? 135.70.128.1 to 135.70.159.254

Show your work for Problem 11 in the space below.

[illegible]

Subnetting

Problem 12

Number of needed usable hosts **45**

Network Address **198.125.50.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 4

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 2

What is the 2nd subnet range? 198.125.50.64 to 198.125.50.127

What is the subnet number for the 2nd subnet? 198.125.50.64

What is the subnet broadcast address for the 4th subnet? 198.125.50.255

What are the assignable addresses for the 3rd subnet? 198.125.50.129 to 198.125.50.190

Show your work for Problem 12 in the space below.

| | | | | | | | | | | | | Number of | |
|-------------------|--|--|--|-----|---------------------------------|----------------------------------|----|----|----|----|-----|-----------|---------------|
| | | | | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | Hosts |
| Number of Subnets | | | | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | |
| | | | | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - | Binary values |
| 198 . 125 . 50 . | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| (1) | | | | 0 | 198.125.50.0 to 198.125.50.63 | | | | | | | | |
| (2) | | | | 1 | 198.125.50.64 to 198.125.50.127 | | | | | | | | |
| (3) | | | | 1 | 0 | 198.125.50.128 to 198.125.50.191 | | | | | | | |
| (4) | | | | 1 | 1 | 198.125.50.192 to 198.125.50.255 | | | | | | | |

$$\begin{array}{r} 128 \\ +64 \\ \hline 192 \end{array}$$

$$\begin{array}{r} 64 \\ -2 \\ \hline 62 \end{array}$$

Subnetting

Problem 13

Network Address **165.200.0.0 /26**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

What is the 10th subnet range? 165.200.2.64 to 165.200.2.127

What is the subnet number for the 11th subnet? 165.200.2.128

What is the subnet broadcast address for the 1023rd subnet? 165.200.255.191

What are the assignable addresses for the 1022nd subnet? 165.200.255.65 to 165.200.255.126

Show your work for Problem 13 in the space below.

| | | | | | | | | | | | | | | | | |
|---------------------|--------|--------|--------|-------|-------|-------|-------|-----|-----|------|------|------|------|-------|-------|-------|
| Number of Hosts - | 65,536 | 32,768 | 16,384 | 8,192 | 4,096 | 2,048 | 1,024 | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| Number of Subnets - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4096 | 8192 | 16384 | 32768 | 65536 |
| Binary values - | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 165.200.0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| to | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 165.200.0.63 | (1) | | | | | | | | | | | | | | | |
| to | 64 | | | | | | | | | | | | | | | |
| 165.200.0.127 | (2) | | | | | | | | | | | | | | | |
| to | 32 | | | | | | | | | | | | | | | |
| 165.200.0.191 | (3) | | | | | | | | | | | | | | | |
| to | 16 | | | | | | | | | | | | | | | |
| 165.200.0.255 | (4) | | | | | | | | | | | | | | | |
| to | 8 | | | | | | | | | | | | | | | |
| 165.200.1.63 | (5) | | | | | | | | | | | | | | | |
| to | 4 | | | | | | | | | | | | | | | |
| 165.200.1.127 | (6) | | | | | | | | | | | | | | | |
| to | 2 | | | | | | | | | | | | | | | |
| 165.200.1.191 | (7) | | | | | | | | | | | | | | | |
| to | +1 | | | | | | | | | | | | | | | |
| 165.200.1.255 | 252 | | | | | | | | | | | | | | | |
| to | 64 | | | | | | | | | | | | | | | |
| 165.200.2.63 | -2 | | | | | | | | | | | | | | | |
| to | 62 | | | | | | | | | | | | | | | |
| 165.200.2.127 | 128 | | | | | | | | | | | | | | | |
| to | +64 | | | | | | | | | | | | | | | |
| 165.200.3.63 | 252 | | | | | | | | | | | | | | | |
| to | 64 | | | | | | | | | | | | | | | |
| 165.200.3.127 | -2 | | | | | | | | | | | | | | | |
| to | 62 | | | | | | | | | | | | | | | |
| 165.200.3.191 | 128 | | | | | | | | | | | | | | | |
| to | +64 | | | | | | | | | | | | | | | |
| 165.200.3.255 | 252 | | | | | | | | | | | | | | | |
| to | 64 | | | | | | | | | | | | | | | |
| 165.200.3.255 | -2 | | | | | | | | | | | | | | | |
| to | 62 | | | | | | | | | | | | | | | |
| 165.200.255.64 | (1021) | | | | | | | | | | | | | | | |
| to | 128 | | | | | | | | | | | | | | | |
| 165.200.255.127 | (1022) | | | | | | | | | | | | | | | |
| to | 64 | | | | | | | | | | | | | | | |
| 165.200.255.191 | (1023) | | | | | | | | | | | | | | | |
| to | 32 | | | | | | | | | | | | | | | |
| 165.200.255.255 | 252 | | | | | | | | | | | | | | | |
| to | 64 | | | | | | | | | | | | | | | |

Subnetting

Problem 14

Number of needed usable hosts **16**

Network Address **200.10.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

What is the 7th subnet range? 200.10.10.192 to 200.10.10.223

What is the subnet number for the 5th subnet? 200.10.10.128

What is the subnet broadcast address for the 4th subnet? 200.10.10.127

What are the assignable addresses for the 6th subnet? 200.10.10.161 to 200.10.10.190

Show your work for Problem 14 in the space below.

| Number of Subnets | | | | Number of Hosts | | | | | Binary values | | | | |
|-----------------------|-----|-----|----|-----------------|----|---------------|-----|-----|---------------|--|--|--|--|
| | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | - | | | | |
| - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | | | | | |
| | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - | | | | |
| 200 . 10 . 10 . 0 0 0 | | | | 0 | 0 | 0 | 0 | 0 | | | | | |
| (1) | | | 0 | 200.10.10.0 | to | 200.10.10.31 | | | | | | | |
| (2) | | | 1 | 200.10.10.32 | to | 200.10.10.63 | | | | | | | |
| (3) | | 1 | 0 | 200.10.10.64 | to | 200.10.10.95 | | | | | | | |
| (4) | | 1 | 1 | 200.10.10.96 | to | 200.10.10.127 | | | | | | | |
| (5) | 1 | 0 | 0 | 200.10.10.128 | to | 200.10.10.159 | | | | | | | |
| (6) | 1 | 0 | 1 | 200.10.10.160 | to | 200.10.10.191 | | | | | | | |
| (7) | 1 | 1 | 0 | 200.10.10.192 | to | 200.10.10.223 | | | | | | | |
| (8) | 1 | 1 | 1 | 200.10.10.224 | to | 200.10.10.255 | | | | | | | |

$$\begin{array}{r}
 128 \\
 64 \\
 +32 \\
 \hline
 224
 \end{array}
 \qquad
 \begin{array}{r}
 32 \\
 -2 \\
 \hline
 30
 \end{array}$$

Subnetting

Problem 15

Network Address **93.0.0.0 /19**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 224 . 0

Total number of subnets 2,048

Total number of host addresses 8,192

Number of usable addresses 8,190

Number of bits borrowed 11

What is the 15th subnet range? 93.1.192.0 to 93.1.223.255

What is the subnet number for the 9th subnet? 93.1.0.0

What is the subnet broadcast address for the 7th subnet? 93.0.223.255

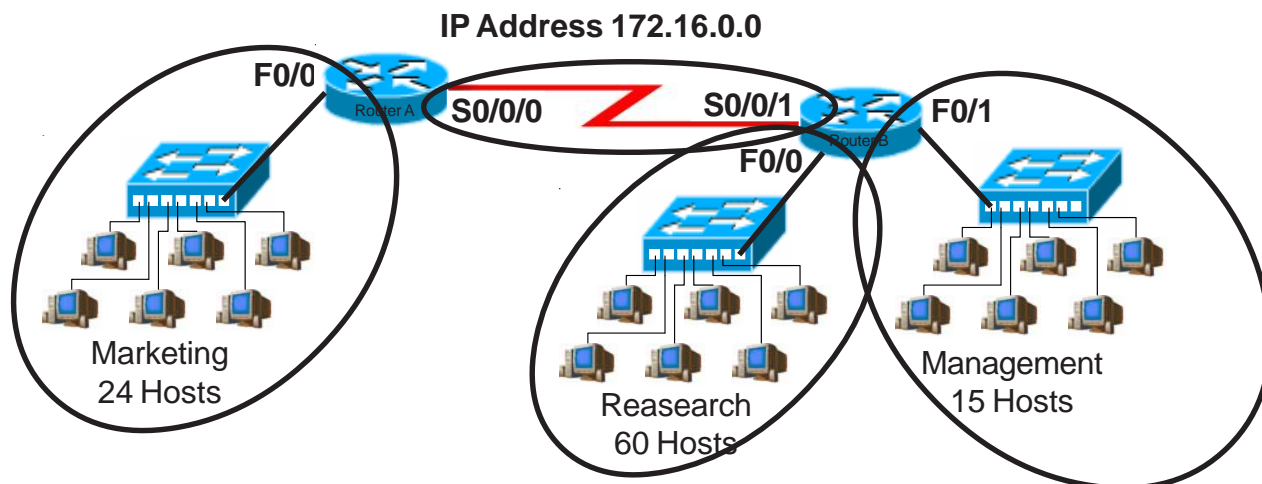
What are the assignable addresses for the 12th subnet? 93.1.96.1 to 93.1.127.254

Show your work for **Problem 15** in the space below.

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------|---|---|---|---|----|----|----|-----|-----|-----|------|------|------|------|-------|-------|-------|--------|--------|--------|---------|---------|---------|---------|----------|----------|----------|-----------|-----------|-----------|------------|------------|------------|------------|-------------|-------------|-------------|--------------|--------------|--------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|---------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|------------------------------------------|-----------------------------------------|-----------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|------------------------------|
| Number of Hosts | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4096 | 8192 | 16384 | 32768 | 65536 | 131072 | 262144 | 524288 | 1048576 | 2097152 | 4194304 | 8388608 | 16777216 | 33554432 | 67108864 | 134217728 | 268435456 | 536870912 | 1073741824 | 2147483648 | 4294967296 | 8589934592 | 17179869184 | 34359738368 | 68719476736 | 137438953472 | 274877906944 | 549755813888 | 1099511627776 | 2199023255552 | 4398046511104 | 8796093022208 | 17592186044416 | 35184372088832 | 70368744177664 | 140737488355328 | 281474976710656 | 562949953421312 | 1125899906842624 | 2251799813685248 | 4503599627370496 | 9007199254740992 | 18014398509481984 | 36028797018963968 | 72057594037927936 | 144115188075855872 | 288230376151711744 | 576460752303423488 | 1152921504606846976 | 2305843009213693952 | 4611686018427387904 | 9223372036854775808 | 18446744073709551616 | 36893488147419103232 | 73786976294838206464 | 147573952589676412928 | 295147905179352825856 | 590295810358705651712 | 1180591620717411303424 | 2361183241434822606848 | 4722366482869645213696 | 9444732965739290427392 | 18889465931478580854784 | 37778931862957161709568 | 75557863725914323419136 | 151115727451828646838272 | 302231454903657293676544 | 604462909807314587353088 | 1208925819614629174706176 | 2417851639229258349412352 | 4835703278458516698824704 | 9671406556917033397649408 | 19342813113834066795298816 | 38685626227668133590597632 | 77371252455336267181195264 | 154742504910672534362390528 | 309485009821345068724781056 | 618970019642690137449562112 | 1237940039285380274899124224 | 2475880078570760549798248448 | 4951760157141521099596496896 | 9903520314283042199192993792 | 19807040628566084398385987584 | 39614081257132168796771975168 | 79228162514264337593543950336 | 158456325028528675187087900672 | 316912650057057350374175801344 | 633825300114114700748351602688 | 1267650600228229401496703205376 | 2535301200456458802993406410752 | 5070602400912917605986812821504 | 10141204801825835211973625643008 | 20282409603651670423947251286016 | 40564819207303340847894502572032 | 81129638414606681695789005144064 | 162259276829213363391578010288128 | 324518553658426726783156020576256 | 649037107316853453566312041152512 | 1298074214633706907132624082305024 | 2596148429267413814265248164610048 | 5192296858534827628530496329220096 | 10384593717069655257060992658440192 | 20769187434139310514121985316880384 | 41538374868278621028243970633760768 | 83076749736557242056487941267521536 | 166153499473114484112975882535043072 | 332306998946228968225951765070086144 | 664613997892457936451903530140172288 | 1329227995784915872903807060280344576 | 2658455991569831745807614120560689152 | 5316911983139663491615228241121378304 | 10633823966279326983230456482242756608 | 21267647932558653966460912964485513216 | 42535295865117307932921825928971026432 | 85070591730234615865843651857942052864 | 170141183460469231731687303715884105728 | 340282366920938463463374607431768211456 | 680564733841876926926749214863536422912 | 1361129467683753853853498429727072845824 | 272225893536750770770699685945414569152 | 544451787073501541541399371890829138304 | 1088903574147003083082798743781658276608 | 2177807148294006166165597487563316553216 | 4355614296588012332331194975126633106432 | 8711228593176024664662389950253266212864 | 17422457186352049329324779900506532425728 | 34844914372704098658649559801013064851456 | 69689828745408197317299119602026129702912 | 139379657490816394634598239204052259405824 | 278759314981632789269196478408104518811648 | 557518629963265578538392956816209037623296 | 1115037259926531157076785913632418075247392 | 2230074519853062314153571827264836150494784 | 4460149039706124628307143654529672300989568 | 8920298079412249256614287309059344601979136 | 1784059615882449851322857461 |
|-----------------|---|---|---|---|----|----|----|-----|-----|-----|------|------|------|------|-------|-------|-------|--------|--------|--------|---------|---------|---------|---------|----------|----------|----------|-----------|-----------|-----------|------------|------------|------------|------------|-------------|-------------|-------------|--------------|--------------|--------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|---------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|------------------------------------------|-----------------------------------------|-----------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|------------------------------|

Practical Subnetting 1

Based on the information in the graphic shown, design a network addressing scheme that will supply the minimum number of subnets, and allow enough extra subnets and hosts for 100% growth in both areas. Circle each subnet on the graphic and answer the questions below.



| | |
|------------------------------------------------------------------------------------------------------------|----------------------|
| Address class | <u>B</u> |
| Custom subnet mask | <u>255.255.224.0</u> |
| Minimum number of subnets needed | <u>4</u> |
| Extra subnets required for 100% growth (Round up to the next whole number) | <u>+ 4</u> |
| Total number of subnets needed | <u>= 8</u> |
| Number of host addresses in the largest subnet group | <u>60</u> |
| Number of addresses needed for 100% growth in the largest subnet (Round up to the next whole number) | <u>+ 60</u> |
| Total number of address needed for the largest subnet | <u>= 120</u> |

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

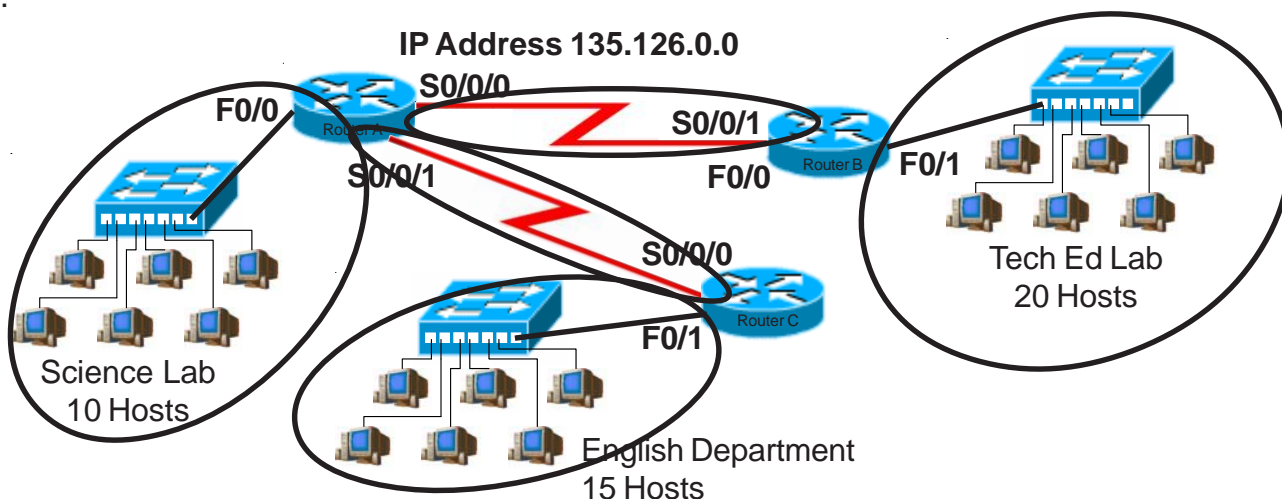
| | |
|----------------------------------------------------------------|-----------------------------------|
| IP address range for Research | <u>172.16.0.0 to 172.31.255</u> |
| IP address range for Marketing | <u>172.16.32.0 to 172.63.255</u> |
| IP address range for Management | <u>172.16.64.0 to 172.95.255</u> |
| IP address range for Router A to Router B serial connection | <u>172.16.96.0 to 172.127.255</u> |

Show your work for Practical Subnetting 1 in the space below.

[illegible]

Practical Subnetting 2

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 30% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class B

Custom subnet mask 255.255.255.224

Minimum number of subnets needed 5

Extra subnets required for 30% growth + 2
(Round up to the next whole number)

Total number of subnets needed = 7

Number of host addresses in the largest subnet group 20

Number of addresses needed for 30% growth in the largest subnet + 6
(Round up to the next whole number)

Total number of address needed for the largest subnet = 26

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Tech Ed 135.126.0.0 to 135.126.0.31

IP address range for English 135.126.0.32 to 135.126.0.63

IP address range for Science 135.126.0.64 to 135.126.0.95

IP address range for Router A to Router B serial connection 135.126.0.96 to 135.126.0.127

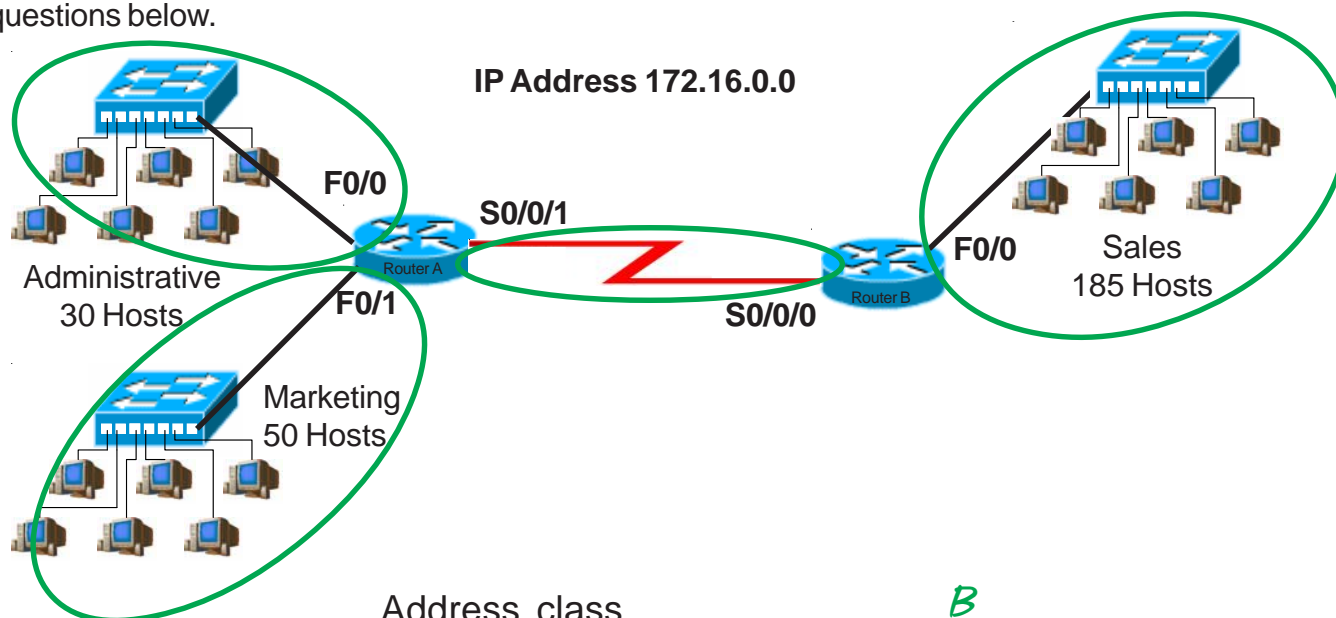
IP address range for Router A to Router C serial connection 135.126.0.128 to 135.126.0.159

Show your work for Problem 2 in the space below.

| | | | | | | | | | | | | | | | | |
|---------------------|--------|--------|--------|-------|-------|-------|-------|-----|-----|-------|-------|-------|-------|--------|--------|--------|
| Number of Hosts - | 65,536 | 32,768 | 16,384 | 8,192 | 4,096 | 2,048 | 1,024 | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| Number of Subnets - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1,024 | 2,048 | 4,096 | 8,192 | 16,384 | 32,768 | 65,536 |
| Binary values - | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 135.126.0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (1) | . | | | | | | | | | | | | | | | |
| (2) | | | | | | | | | | | | | | | | |
| (3) | | | | | | | | | | | | | | | | |
| (4) | | | | | | | | | | | | | | | | |
| (5) | | | | | | | | | | | | | | | | |
| (6) | | | | | | | | | | | | | | | | |
| (7) | | | | | | | | | | | | | | | | |
| (8) | | | | | | | | | | | | | | | | |
| (9) | | | | | | | | | | | | | | | | |
| (10) | | | | | | | | | | | | | | | | |
| (11) | | | | | | | | | | | | | | | | |
| (12) | | | | | | | | | | | | | | | | |
| (13) | | | | | | | | | | | | | | | | |
| (14) | | | | | | | | | | | | | | | | |
| (15) | | | | | | | | | | | | | | | | |
| (16) | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | |
| x.3 | | | | | | | | | | | | | | | | |
| 1.5 | | | | | | | | | | | | | | | | |
| (Round up to 2) | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | |
| x.3 | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | |
| 135.126.0.31 | to | | | | | | | | | | | | | | | |
| 135.126.0.63 | to | | | | | | | | | | | | | | | |
| 135.126.0.95 | to | | | | | | | | | | | | | | | |
| 135.126.0.127 | to | | | | | | | | | | | | | | | |
| 135.126.0.159 | to | | | | | | | | | | | | | | | |
| 135.126.0.191 | to | | | | | | | | | | | | | | | |
| 135.126.0.223 | to | | | | | | | | | | | | | | | |
| 135.126.0.255 | to | | | | | | | | | | | | | | | |
| 135.126.1.31 | to | | | | | | | | | | | | | | | |
| 135.126.1.63 | to | | | | | | | | | | | | | | | |
| 135.126.1.95 | to | | | | | | | | | | | | | | | |
| 135.126.1.127 | to | | | | | | | | | | | | | | | |
| 135.126.1.159 | to | | | | | | | | | | | | | | | |
| 135.126.1.191 | to | | | | | | | | | | | | | | | |
| 135.126.1.223 | to | | | | | | | | | | | | | | | |
| 135.126.1.255 | to | | | | | | | | | | | | | | | |

Practical Subnetting 3

Based on the information in the graphic shown, design a classfull network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 25% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class B

Custom subnet mask 255.255.255.0

Minimum number of subnets needed 4

Extra subnets required for 25% growth + 1
(Round up to the next whole number)

Total number of subnets needed = 5

Number of host addresses in the largest subnet group 185

Number of addresses needed for 25% growth in the largest subnet + 47
(Round up to the next whole number)

Total number of address needed for the largest subnet = 232

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Sales 172.16.0.0 to 172.16.0.255

IP address range for Marketing 172.16.1.0 to 172.16.1.255

IP address range for Administrative 172.16.2.0 to 172.16.2.255

IP address range for Router A to Router B serial connection 172.16.3.0 to 172.16.3.255

Show your work for Problem 3 in the space below.

Number of Hosts -

Number of Subnets -

Binary values -

65,536

32,768

16,384

8,192

4,096

2,048

1,024

512

2

4

8

16

32

64

128

256

172.16.0.0

0.0.0.0

0.0.0.0

0.0.0.0

0.0.0.0

0.0.0.0

0.0.0.0

0.0.0.0

(1)

(2)

(3)

(4)

(5)

(6)

(7)

(8)

(9)

(10)

(11)

(12)

(13)

(14)

(15)

(16)

172.16.0.0

172.16.1.0

172.16.2.0

172.16.3.0

172.16.4.0

172.16.5.0

172.16.6.0

172.16.7.0

172.16.8.0

172.16.9.0

172.16.10.0

172.16.11.0

172.16.12.0

172.16.13.0

172.16.14.0

172.16.15.0

to

to

to

to

to

to

to

to

to

to

to

to

to

to

to

to

172.16.0.255

172.16.1.255

172.16.2.255

172.16.3.255

172.16.4.255

172.16.5.255

172.16.6.255

172.16.7.255

172.16.8.255

172.16.9.255

172.16.10.255

172.16.11.255

172.16.12.255

172.16.13.255

172.16.14.255

172.16.15.255

4

x.25

1

225

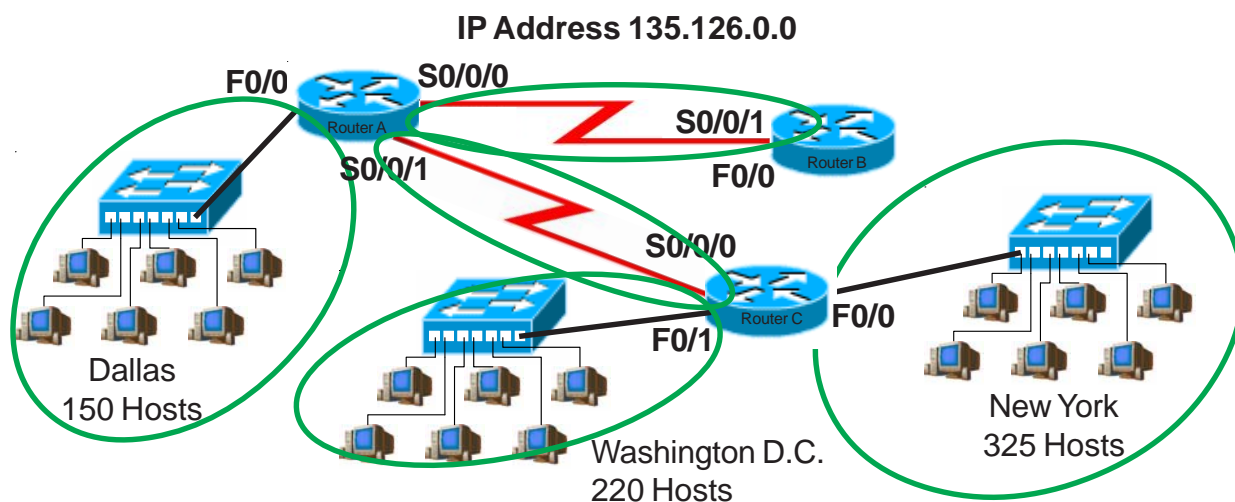
x.25

56.25

(Round up to 57)

Practical Subnetting 4

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of subnets**, and allow enough extra subnets and hosts for 70% growth in all areas. Circle each subnet on the graphic and answer the questions below. Circle each subnet on the graphic and answer the questions below.



Custom subnet mask

255.255.240.0

Minimum number of subnets needed

5

Extra subnets required for 70% growth
(Round up to the next whole number)

+ 4

Total number of subnets needed

= 9

Number of host addresses
in the largest subnet group

325

Number of addresses needed for
70% growth in the largest subnet
(Round up to the next whole number)

+ 228

Total number of address
needed for the largest subnet

= 553

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for New York 135.126.0.0 to 135.126.15.255

IP address range for Washington D. C. 135.126.16.0 to 135.126.31.255

IP address range for Dallas 135.126.32.0 to 135.126.47.255

IP address range for Router A
to Router B serial connection 135.126.48.0 to 135.126.63.255

IP address range for Router A
to Router C serial connection 135.126.64.0 to 135.126.79.255

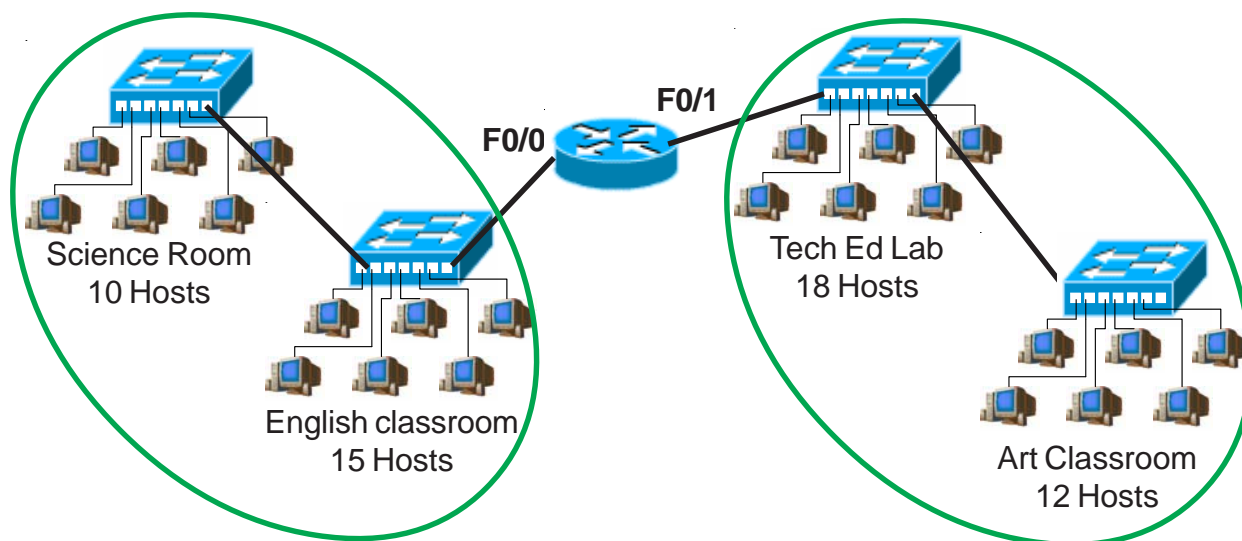
Show your work for Problem 4 in the space below.

| | | | | | | | | | | | | | | | | |
|---------------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Number of Hosts - | 65,536 | 32,768 | 16,384 | 8,192 | 4,096 | 2,048 | 1,024 | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| Number of Subnets - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1,024 | 2,048 | 4,096 | 8,192 | 16,384 | 32,768 | 65,536 |
| Binary values - | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | . | . | . | . | . | . | . | . |
| 135.126.0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (1) | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| (2) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (3) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (4) | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (5) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (6) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (7) | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (8) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (9) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (10) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (11) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (12) | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (13) | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (14) | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (15) | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (16) | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 135.126.0.0 | 135.126.0.0 | 135.126.16.0 | 135.126.32.0 | 135.126.48.0 | 135.126.64.0 | 135.126.80.0 | 135.126.96.0 | 135.126.112.0 | 135.126.128.0 | 135.126.144.0 | 135.126.160.0 | 135.126.176.0 | 135.126.192.0 | 135.126.208.0 | 135.126.224.0 | 135.126.240.0 |
| to | to | to | to | to | to | to | to | to | to | to | to | to | to | to | to | to |
| 135.126.15.255 | 135.126.31.255 | 135.126.47.255 | 135.126.63.255 | 135.126.79.255 | 135.126.95.255 | 135.126.111.255 | 135.126.127.255 | 135.126.143.255 | 135.126.159.255 | 135.126.175.255 | 135.126.191.255 | 135.126.207.255 | 135.126.223.255 | 135.126.239.255 | 135.126.255.255 | 135.126.255.255 |

Practical Subnetting 5

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 100% growth in all areas. Circle each subnet on the graphic and answer the questions below.

IP Address 210.15.10.0



| | |
|------------------------------------------------------------------------------------------------------------|------------------------|
| Address class | <u>C</u> |
| Custom subnet mask | <u>255.255.255.192</u> |
| Minimum number of subnets needed | <u>2</u> |
| Extra subnets required for 100% growth (Round up to the next whole number) | <u>+ 2</u> |
| Total number of subnets needed | <u>= 4</u> |
| Number of host addresses in the largest subnet group | <u>30</u> |
| Number of addresses needed for 100% growth in the largest subnet (Round up to the next whole number) | <u>+ 30</u> |
| Total number of address needed for the largest subnet | <u>= 60</u> |

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Router F0/0 Port 210.15.10.0 to 210.15.10.63

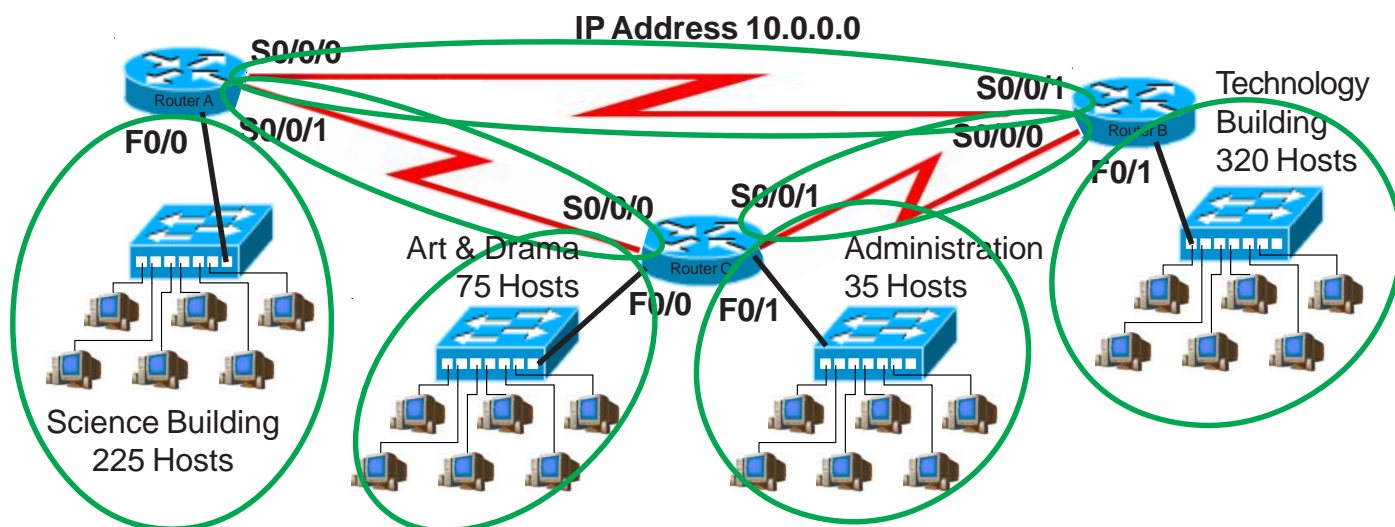
IP address range for Router F0/1 Port 210.15.10.64 to 210.15.10.127

Show your work for Problem 5 in the space below.

| | | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | - | Number of Hosts |
|---------------------------------------|-----|---------------|-----|----|----|----|----|---------------|-----|-----|-----------------|
| Number of Subnets | | - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | |
| | | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - | Binary values |
| 210. 15 . 10 . 0 0 0 0 0 0 0 0 | | | | | | | | | | | |
| (1) | 0 | 210.15.10.0 | | | | to | | 210.15.10.63 | | | |
| (2) | 1 | 210.15.10.64 | | | | to | | 210.15.10.127 | | | |
| (3) | 1 0 | 210.15.10.128 | | | | to | | 210.15.10.191 | | | |
| (4) | 1 1 | 210.15.10.192 | | | | to | | 210.15.10.255 | | | |

Practical Subnetting 6

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of subnets**, and allow enough extra subnets and hosts for 20% growth in all areas. Circle each subnet on the graphic and answer the questions below. Circle each subnet on the graphic and answer the questions below.



| | |
|------------------------------------------------------------------------------|--------------------|
| Address class | <u>A</u> |
| Custom subnet mask | <u>255.240.0.0</u> |
| Minimum number of subnets needed | <u>7</u> |
| Extra subnets required for 20% growth (Round up to the next whole number) | <u>+ 2</u> |
| Total number of subnets needed | <u>= 9</u> |

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

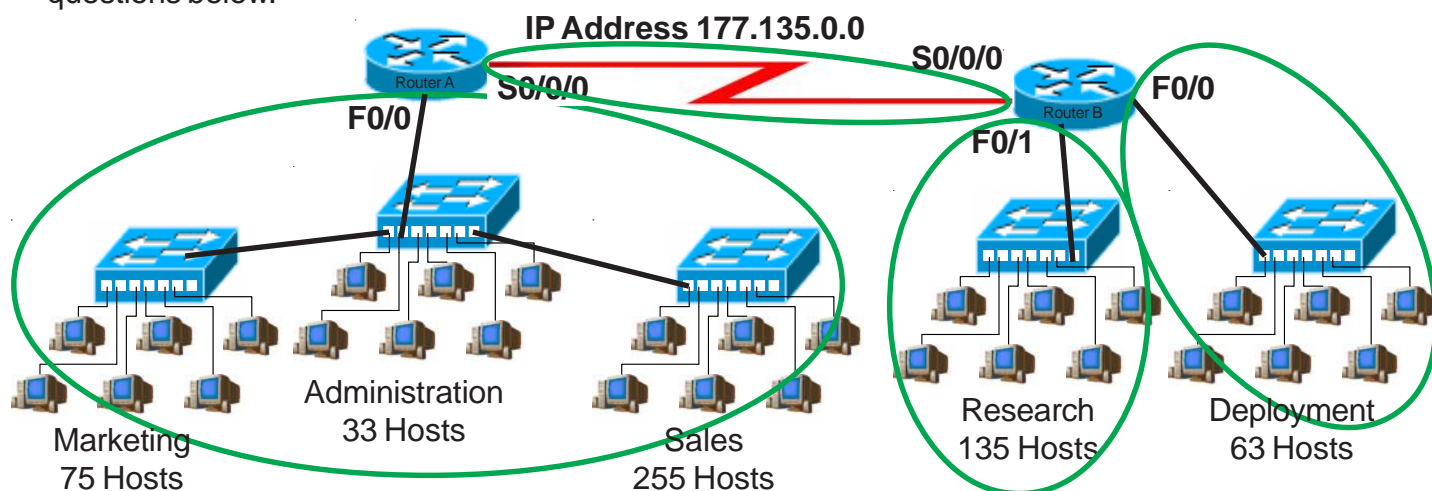
| | |
|----------------------------------------------------------------|------------------------------------|
| IP address range for Technology | <u>10.0.0.0 to 10.15.255.255</u> |
| IP address range for Science | <u>10.16.0.0 to 10.31.255.255</u> |
| IP address range for Arts & Drama | <u>10.32.0.0 to 10.47.255.255</u> |
| IP Address range Administration | <u>10.48.0.0 to 10.63.255.255</u> |
| IP address range for Router A to Router B serial connection | <u>10.64.0.0 to 10.79.255.255</u> |
| IP address range for Router A to Router C serial connection | <u>10.80.0.0 to 10.95.255.255</u> |
| IP address range for Router B to Router C serial connection | <u>10.96.0.0 to 10.111.255.255</u> |

Show your work for Problem 6 in the space below.

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------|---|---|---|---|----|----|----|-----|-----|-----|-------|-------|-------|-------|--------|--------|--------|---------|---------|---------|-----------|-----------|-----------|-----------|------------|------------|------------|-------------|-------------|-------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|---------------------------------------------------|---------------------------------------------------|---------------------------------------------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|----------------------------------------------------|
| Number of Hosts | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1,024 | 2,048 | 4,096 | 8,192 | 16,384 | 32,768 | 65,536 | 131,072 | 262,144 | 524,288 | 1,048,576 | 2,097,152 | 4,194,304 | 8,388,608 | 16,777,216 | 33,554,432 | 67,108,864 | 134,217,728 | 268,435,456 | 536,870,912 | 1,073,741,824 | 2,147,483,648 | 4,294,967,296 | 8,589,934,592 | 17,179,869,184 | 34,359,738,368 | 68,719,476,736 | 137,438,953,472 | 274,877,906,944 | 549,755,813,888 | 1,099,511,627,776 | 2,199,023,255,552 | 4,398,046,511,104 | 8,796,093,022,208 | 17,592,186,044,416 | 35,184,372,088,832 | 70,368,744,177,664 | 140,737,488,355,328 | 281,474,976,710,656 | 562,949,953,421,312 | 1,125,899,906,842,624 | 2,251,799,813,685,248 | 4,503,599,627,370,496 | 9,007,199,254,740,992 | 18,014,398,509,481,984 | 36,028,797,018,963,968 | 72,057,594,037,927,936 | 144,115,188,075,855,872 | 288,230,376,151,711,744 | 576,460,752,303,423,488 | 1,152,921,504,606,846,976 | 2,305,843,009,213,693,952 | 4,611,686,018,427,387,904 | 9,223,372,036,854,775,808 | 18,446,744,073,709,551,616 | 36,893,488,147,419,103,232 | 73,786,976,294,838,206,464 | 147,573,952,589,676,412,928 | 295,147,905,179,352,825,856 | 590,295,810,358,705,651,712 | 1,180,591,620,717,411,303,424 | 2,361,183,241,434,822,606,848 | 4,722,366,482,869,645,213,696 | 9,444,732,965,739,290,427,392 | 18,889,465,931,478,580,846,784 | 37,778,931,862,957,161,693,568 | 75,557,863,725,914,323,387,136 | 151,115,727,451,828,646,774,272 | 302,231,454,903,657,293,548,544 | 604,462,909,807,314,587,097,088 | 1,208,925,819,614,629,174,194,176 | 2,417,851,639,229,258,348,388,352 | 4,835,703,278,458,516,696,776,704 | 9,671,406,556,917,033,393,553,408 | 19,342,813,113,834,066,787,106,816 | 38,685,626,227,668,133,574,213,632 | 77,371,252,455,336,267,148,427,264 | 154,742,504,910,672,534,296,854,528 | 309,485,009,821,345,068,593,709,056 | 618,970,019,642,690,137,187,418,112 | 1,237,940,039,285,380,274,374,836,224 | 2,475,880,078,570,760,548,749,672,448 | 4,951,760,157,141,521,097,499,344,896 | 9,903,520,314,283,042,194,998,689,792 | 19,807,040,628,566,084,389,997,379,584 | 39,614,081,257,132,168,779,994,759,168 | 79,228,162,514,264,337,559,989,518,336 | 158,456,325,028,528,675,119,979,036,672 | 316,912,650,057,057,350,239,958,073,344 | 633,825,300,114,114,700,479,916,146,688 | 1,267,650,600,228,229,400,959,832,293,376 | 2,535,301,200,456,458,801,919,664,586,752 | 5,070,602,400,912,917,603,839,329,173,504 | 10,141,204,801,825,835,207,678,658,347,008 | 20,282,409,603,651,670,415,357,317,694,016 | 40,564,819,207,303,340,830,714,635,388,032 | 81,129,638,414,606,681,661,429,270,776,064 | 162,259,276,829,213,363,322,858,541,552,128 | 324,518,553,658,426,726,645,717,103,104,256 | 649,037,107,316,853,453,291,434,206,208,512 | 1,298,074,214,633,706,906,582,868,402,416,024 | 2,596,148,429,267,413,813,165,736,812,832,048 | 5,192,296,858,534,827,626,331,473,625,664,096 | 10,384,593,717,069,655,252,662,947,249,328,192 | 20,769,187,434,139,310,505,325,894,498,656,384 | 41,538,374,868,278,621,010,651,788,997,312,768 | 83,076,749,736,557,242,021,303,577,995,625,536 | 166,153,499,473,114,484,042,607,155,991,251,072 | 332,306,998,946,228,968,084,214,311,982,502,144 | 664,613,997,892,457,936,168,428,623,965,004,288 | 1,329,227,995,784,915,872,336,857,247,930,016,576 | 2,658,455,971,569,831,744,673,714,495,860,033,152 | 5,316,911,943,139,663,489,347,428,981,720,066,304 | 10,633,823,886,279,326,978,694,857,963,440,132,608 | 21,267,647,772,558,653,957,389,715,926,880,265,216 | 42,535,295,545,117,307,914,779,431,853,760,530,432 | 85,070,591,090,234,615,829,838,863,707,520,106,864 | 170,141,182,180,469,231,659,677,727,415,041,213,728 | 340,282,364,360,938,463,319,355,454,830,027,457,456 | 680,564,728,721,876,926,638,710,909,660,054,914,912 | 1,361,129,457,443,753,853,277,421,821,320,109,829,824 | 2,722,258,914,887,507,706,544,843,642,640,219,659,648 | 5,444,517,829,775,015,413,089,687,285,281,319,319,312 | 10,889,035,659,550,030,826,178,374,570,562,638,638,624 | 21,778,071,319,100,061,652,356,748,141,125,267,277,248 | 43,556,142,638,200,123,304,713,496,282,250,534,554,496 | 87,112,285,276,400,246,608,426,982,564,501,069,108,992 | 174,224,570,552,800,493,216,853,965,129,013,817,937,984 | 348,449,141,105,600,986,432,707,930,258,027,635,875,968 | 696,898,282,211,201,972,864,415,860,516,055,271,751,936 | 1,393,796,564,422,403,945,728,831,721,032,103,503,503,872 | 2,787,593,128,844,807,891,457,663,442,064,207,007,007,744 | 5,575,186,257,689,615,782,915,327,324,816,414,014,015,488 | 11,150,372,515,379,231,565,831,654,648,828,028,028,976 | 22,300,745,030,758,463,131,663,309,297,656,056,057,952 | 44,601,490,061,516,926,263,326,618,515,312,112,115,904 | 89,202,980,123,033,852,526,653,237,030,624,224,231,808 | 178,405,960,246,067,705,053,306,474,061,248,448,463,616 | 356,811,920,492,135,410,106,612,948,122,496,896,927,232 | 713,623,840,984,270,820,213,225,896,244,992,179,854,464 | 1,427,247,681,968,541,640,426,451,792,489,984,359,708,928 | 2,854,495,363,937,083,280,852,903,584,979,968,717,816 | 5,708,990,727,874,166,561,705,807,169,959,937,435,632 | 11,417,981,455,748,333,123,411,615,339,919,874,871,264 | 22,835,962,911,496,666,246,823,230,679,839,749,742,528 | 45,671,925,822,993,332,493,646,461,359,679,497,485,056 | 91,343,851,645,986,664,987,292,922,719,358,994,970,112 | 182,687,703,291,973,329,974,585,845,438,717,989,940,224 | 365,375,406,583,946,659,949,171,690,877,437,979,888 | 730,750,813,167,893,319,898,343,381,754,875,959,776 | 1,461,501,626,335,786,639,796,686,763,509,751,919,552 | 2,923,003,252,671,573,279,593,373,527,019,503,839,104 | 5,846,006,505,343,146,559,186,747,054,038,007,678,208 | 11,692,013,010,686,293,118,373,494,108,806,015,356,416 | 23,384,026,021,372,586,236,746,988,217,613,030,712,832 | 46,768,052,042,745,172,473,493,976,435,226,061,425,664 | 93,536,104,085,490,344,946,987,952,870,452,122,851,328 | 187,072,208,170,980,689,893,975,741,740,904,245,702,656 | 374,144,416,341,961,379,787,951,483,481,809,405,411,312 | 748,288,832,683,922,759,575,902,966,963,618,810,822,624 | 1,496,577,665,367,845,519,151,805,933,927,237,621,645,248 | 2,993,155,330,735,691,038,303,611,867,854,455,243,290,496 | 5,986,310,661,471,382,076,607,223,735,708,910,486,580,992 | 11,972,621,322,942,764,153,214,447,471,417,821,973,161,984 | 23,945,242,645,885,528,306,428,894,942,835,643,947,323,968 | 47,890,485,291,771,056,612,857,789,885,687,287,894,647,736 | 95,780,970,583,542,113,225,715,579,771,375,375,789,495,472 | 191,561,941,167,084,226,451,431,159,542,750,751,578,990,944 | 383,123,882,334,168,452,902,862,319,085,501,503,157,980,888 | 766,247,764,668,336,905,805,724,638,171,003,006,315,961,776 | 1,532,495,529,336,673,811,611,449,276,342,006,012,631,923,552 | 3,064,991,058,673,347,623,222,898,552,684,012,025,263,847,104 | 6,129,982,117,346,695,246,445,797,105,368,024,050,527,694,208 | 12,259,964,234,693,390,492,891,594,210,736,048,101,055,351,416 | 24,519,928,469,386,780,985,783,180,461,472,202,102,102,702,832 | 49,039,856,938,773,561,971,566,360,922,944,404,204,205,405,664 | 98,079,713,877,547,123,943,132,721,845,888,808,408,410,811,328 | 196,159,427,755,094,247,887,265,443,691,777,616,816,821,622,656 | 392,318,855,510,188,495,774,530,887,383,555,233,633,645,283,312 | 784,637,711,020,376,991,549,061,774,767,111,467,267,286,666,624 | 1,569,275,422,040,753,983,098,123,549,534,334,934,534,533,248 | 3,138,550,844,081,507,966,196,247,099,068,869,869,068,496 | 6,277,101,688,163,015,932,392,494,198,137,737,738,136,992 | 12,554,203,376,326,031,864,784,988,396,275,475,476,384 | 25,108,406,752,652,063,729,569,977,792,550,950,952,768 | 50,216,813,505,304,127,459,139,955,585,101,911,905,536 | 100,433,627,010,608,254,918,279,911,170,203,823,811,072 | 200,867,254,021,216,509,837,559,822,340,407,647,622,144 | 401,734,508,042,433,019,675,115,644,680,815,295,248,288 | 803,469,016,084,866,039,350,231,289,361,630,590,496,576 | 1,606,938,032,169,732,078,700,462,578,723,261,181,193,152 | 3,213,876,064,339,464,157,400,925,147,446,522,362,386,304 | 6,427,752,128,678,928,314,801,850,294,893,044,724,772,608 | 12,855,504,257,357,856,629,603,700,589,788,089,449,445,216 | 25,711,008,514,715,713,259,207,401,179,578,178,898,890,432 | 51,422,017,029,431,426,518,414,802,359,157,357,797,780,864 | 102,844,034,058,862,853,036,829,604,718,314,715,595,561,728 | 205,688,068,117,725,706,073,659,209,437,629,431,191,123,456 | 411,376,136,235,451,412,147,318,418,874,259,262,382,246,912 | 822,752,272,470,902,824,294,636,836,748,518,524,764,493,824 | 1,645,504,544,941,805,648,589,273,673,437,037,049,528,968 | 3,291,009,089,883,611,297,178,547,346,874,074,098,057,936 | 6,582,018,179,767,222,594,357,094,693,748,148,196,115,872 | 13,164,036,359,534,445,188,717,389,387,496,296,392,231,744 | 26,328,072,719,068,890,377,434,778,794,992,782,463,463,488 | 52,656,145,438,137,780,754,869,557,589,985,564,926,936 | 105,312,290,876,275,561,509,739,115,179,971,129,853,872 | 210,624,581,752,551,123,019,478,230,359,951,759,707,744 | 421,249,163,505,102,246,038,956,460,719,903,519,415,488 | 842,498,327,010,204,492,077,912,921,439,807,038,830,976 | 1,684,996,654,020,408,984,155,825,842,879,614,077,661,952 | 3,369,993,308,040,817,968,311,651,685,759,228,123,323,904 | 6,739,986,616,081,635,936,623,303,371,518,446,246,647,808 | 13,479,973,232,163,271,873,246,606,743,036,892,493,295,616 | 26,959,946,464,326,543,746,493,213,486,073,784,986,591,232 | 53,919,892,928,653,087,492,986,426,972,147,569,973,182,464 | 107,839,785,857,306,174,985,972,853,944,295,139,946,364,928 | 215,679,571,714,612,349,971,945,707,888,590,279,892,729,856 | 431,359,143,429,224,699,943,891,415,777,180,559,785,459,712 | 862,718,286,858,449,399,887,782,831,554,361,369,571,919,424 | 1,725,436,573,716,898,799,775,565,662,702,738,143,938,848 | 3,450,873,147,433,797,599,551,131,325,405,467,887,877,696 | 6,901,746,294,867,595,199,102,262,650,810,935,775,755,392 | 13,803,492,589,735,190,398,204,525,301,621,871,551,510,784 | 27,606,985,179,470,380,796,409,050,603,243,743,103,102,156 | 55,213,970,358,940,761,592,818,101,206,487,486,206,204,312 | 110,427,940,717,881,523,185,636,202,414,974,972,412,408,624 | 220,855,881,435,763,046,371,272,404,829,949,944,824,816 | 441,711,762,871,526,092,742,544,809,659,899,889,649,632 | 883,423,525,743,052,185,485,089,619,319,799,779,299,264 | 1,766,847,051,486,104,370,970,179,238,639,599,558,598,528 | 3,533,694,102,972,208,741,940,358,477,279,199,117,197,056 | 7,067,388,205,944,417,483,880,716,954,558,398,334,394,112 | 14,134,776,411,888,834,967,761,433,909,117,778,668,788,224 | 28,269,552,823,777,669,935,522,867,818,235,557,337,576,448 | 56,539,105,647,555,339,871,045,735,636,471,114,675,153,896 | 113,078,211,295,110,679,742,091,471,272,942,229,347,307,792 | 226,156,422,590,221,359,484,182,942,545,485,694,615,584 | 452,312,845,180,442,718,968,365,885,090,971,389,231,168 | 904,625,690,360,885,437,937,731,770,181,942,778,462,336 | 1,809,251,380,721,770,875,875,463,540,363,885,944,924,672 | 3,618,502,761,443,541,751,750,927,080,727,771,889,848,344 | 7,237,005,522,887,083,503,501,854,161,455,553,779,696,688 | 14,474,011,045,774,167,007,003,708,322,911,117,559,393,376 | 28,948,022,091,548,334,014,007,416,645,822,235,119,118,752 | 57,896,044,183,096,668,028,032,833,291,644,470,238,237,504 | 115,792,088,366,193,336,056,065,666,583,288,476,476,475,008 | 231,584,176,732,386,672,112,131,333,167,576,952,952,950,016 | 463,168,353,464,773,344,224,262,666,335,152,905,905,900,032 | 926,336,706,929,546,688,448,525,332,670,305,811,811,800,064 | 1,852,673,413,859,093,376,896,104,665,340,611,623,623,600,128 | 3,705,346,827,718,186,753,792,209,330,122,246,247,247,256 | 7,410,693,655,436,373,507,584,418,660,244,492,494,494,512 | 14,821,387,310,872,747,015,168,837,320,488,984,988 |
|--------------------|---|---|---|---|----|----|----|-----|-----|-----|-------|-------|-------|-------|--------|--------|--------|---------|---------|---------|-----------|-----------|-----------|-----------|------------|------------|------------|-------------|-------------|-------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|---------------------------------------------------|---------------------------------------------------|---------------------------------------------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|----------------------------------------------------|

Practical Subnetting 7

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 125% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class

B

Custom subnet mask

255.255.252.0

Minimum number of subnets needed

4

Extra subnets required for 125% growth
(Round up to the next whole number)

+ 5

Total number of subnets needed

= 9

Number of host addresses
in the largest subnet group

363

Number of addresses needed for
125% growth in the largest subnet
(Round up to the next whole number)

+ 454

Total number of address
needed for the largest subnet

= 817

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Router A Port F0/0

177.135.0.0 to 177.135.3.255

IP address range for Research

177.135.4.0 to 177.135.7.255

IP address range for Deployment

177.135.8.0 to 177.135.11.255

IP address range for Router A
to Router B serial connection

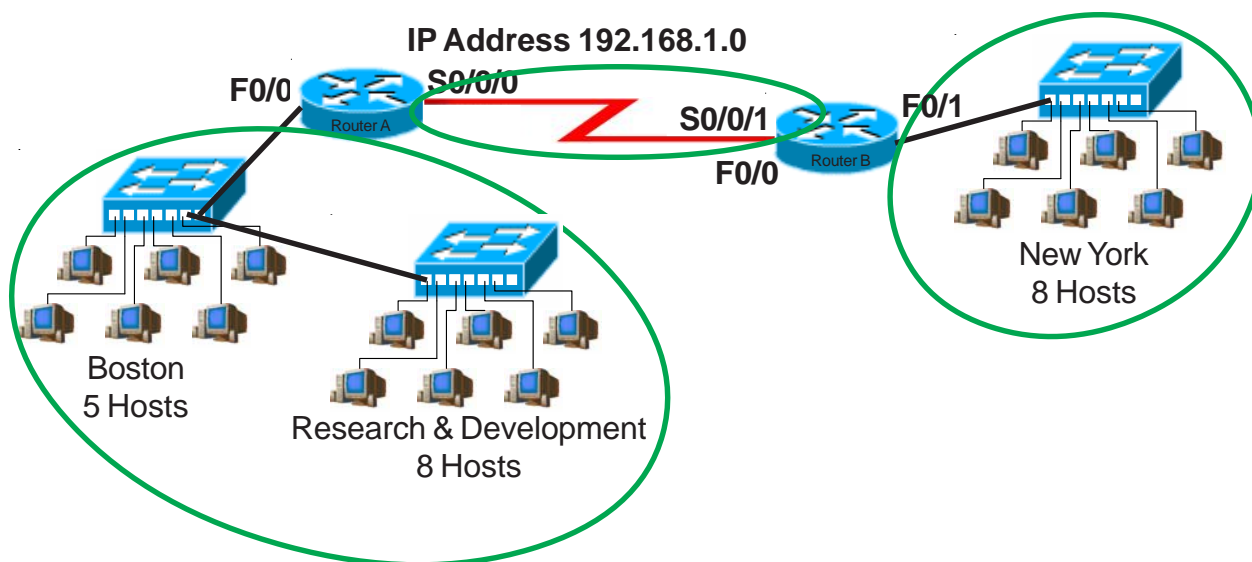
177.135.12.0 to 177.135.15.255

Show your work for Problem 7 in the space below.

| | | | | | | | | | | | | | | | | |
|---------------------|--------|----------------|--------|-------|-------|-------|-------|-----|-----|-------|-------|-------|-------|--------|--------|--------|
| Number of Hosts - | 65,536 | 32,768 | 16,384 | 8,192 | 4,096 | 2,048 | 1,024 | 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 |
| Number of Subnets - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1,024 | 2,048 | 4,096 | 8,192 | 16,384 | 32,768 | 65,536 |
| Binary values - | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 177.135 . | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (1) | . | | | | | | | | | | | | | | | |
| (2) | | | | | | | | | | | | | | | | |
| (3) | | | | | | | | | | | | | | | | |
| (4) | | | | | | | | | | | | | | | | |
| (5) | | | | | | | | | | | | | | | | |
| (6) | | | | | | | | | | | | | | | | |
| (7) | | | | | | | | | | | | | | | | |
| (8) | | | | | | | | | | | | | | | | |
| (9) | | | | | | | | | | | | | | | | |
| (10) | | | | | | | | | | | | | | | | |
| (11) | | | | | | | | | | | | | | | | |
| (12) | | | | | | | | | | | | | | | | |
| (13) | | | | | | | | | | | | | | | | |
| (14) | | | | | | | | | | | | | | | | |
| (15) | | | | | | | | | | | | | | | | |
| (16) | | | | | | | | | | | | | | | | |
| 177.135.0.0 | to | 177.135.3.255 | | | | | | | | | | | | | | |
| 177.135.4.0 | to | 177.135.7.255 | | | | | | | | | | | | | | |
| 177.135.8.0 | to | 177.135.11.255 | | | | | | | | | | | | | | |
| 177.135.12.0 | to | 177.135.15.255 | | | | | | | | | | | | | | |
| 177.135.16.0 | to | 177.135.19.255 | | | | | | | | | | | | | | |
| 177.135.20.0 | to | 177.135.23.255 | | | | | | | | | | | | | | |
| 177.135.24.0 | to | 177.135.27.255 | | | | | | | | | | | | | | |
| 177.135.28.0 | to | 177.135.31.255 | | | | | | | | | | | | | | |
| 177.135.32.0 | to | 177.135.35.255 | | | | | | | | | | | | | | |
| 177.135.36.0 | to | 177.135.39.255 | | | | | | | | | | | | | | |
| 177.135.40.0 | to | 177.135.43.255 | | | | | | | | | | | | | | |
| 177.135.44.0 | to | 177.135.47.255 | | | | | | | | | | | | | | |
| 177.135.48.0 | to | 177.135.51.255 | | | | | | | | | | | | | | |
| 177.135.52.0 | to | 177.135.55.255 | | | | | | | | | | | | | | |
| 177.135.56.0 | to | 177.135.59.255 | | | | | | | | | | | | | | |
| 177.135.60.0 | to | 177.135.63.255 | | | | | | | | | | | | | | |

Practical Subnetting 8

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number subnets**, and allow enough extra subnets and hosts for 85% growth in all areas. Circle each subnet on the graphic and answer the questions below. Circle each subnet on the graphic and answer the questions below.



Address class C

Custom subnet mask 255.255.255.224

Minimum number of subnets needed 3

Extra subnets required for 85% growth + 3
(Round up to the next whole number)

Total number of subnets needed = 6

Number of host addresses
in the largest subnet group 13

Number of addresses needed for
85% growth in the largest subnet + 12
(Round up to the next whole number)

Total number of address
needed for the largest subnet = 25

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Router A F0/0 192.168.1.0 to 192.168.1.31

IP address range for New York 192.168.1.32 to 192.168.1.63

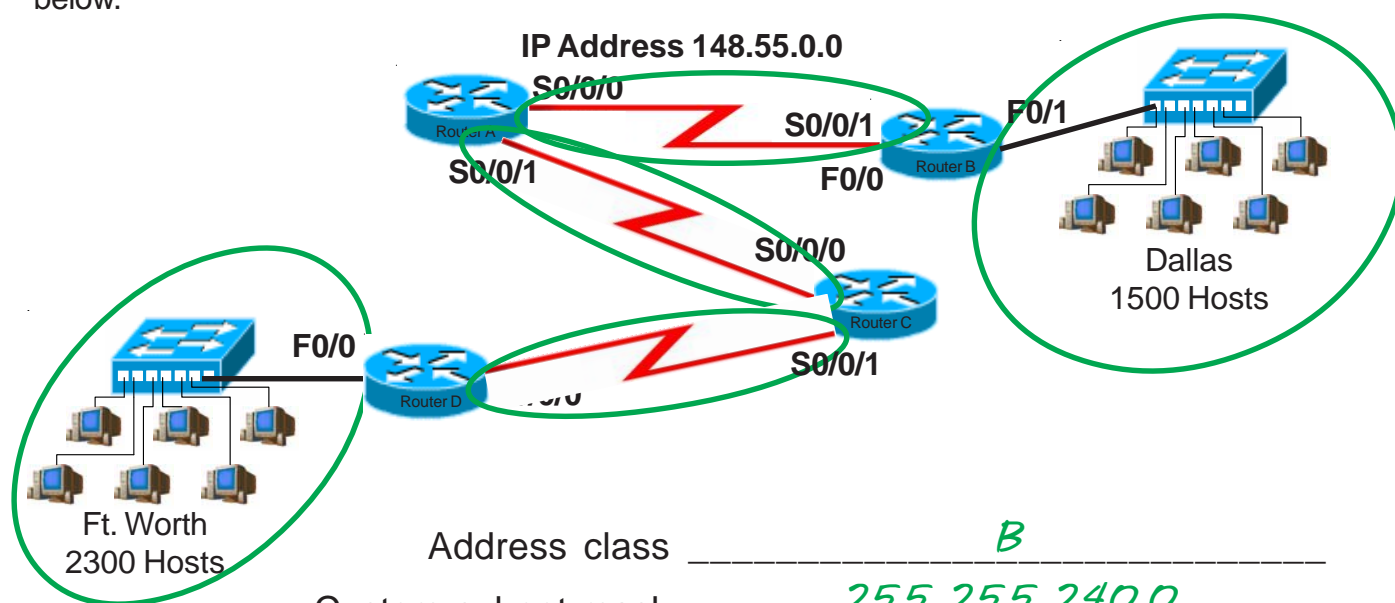
IP address range for Router A
to Router B serial connection 192.168.1.64 to 192.168.1.95

Show your work for Problem 8 in the space below.

| Number of Subnets | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | - | Number of Hosts |
|------------------------------|-----|-----|----|---------------|----|---------------|-----|-----|---|--------------------|
| | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | | |
| | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | - | Binary values |
| 192.168.1.0 0 0 0 0 0 | | | | | | | | | | |
| (1) | | | 0 | 192.168.1.0 | to | 192.168.1.31 | | | | |
| (2) | | | 1 | 192.168.1.32 | to | 192.168.1.63 | | | | |
| (3) | | 1 | 0 | 192.168.1.64 | to | 192.168.1.95 | | | | |
| (4) | | 1 | 1 | 192.168.1.96 | to | 192.168.1.127 | | | | |
| (5) | 1 | 0 | 0 | 192.168.1.128 | to | 192.168.1.159 | | | | |
| (6) | 1 | 0 | 1 | 192.168.1.160 | to | 192.168.1.191 | | | | |
| (7) | 1 | 1 | 0 | 192.168.1.192 | to | 192.168.1.223 | | | | |
| (8) | 1 | 1 | 1 | 192.168.1.224 | to | 192.168.1.255 | | | | |

Practical Subnetting 9

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 15% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class

B

Custom subnet mask

255.255.240.0

Minimum number of subnets needed

5

Extra subnets required for 15% growth
(Round up to the next whole number)

+ 1

Total number of subnets needed

= 6

Number of host addresses
in the largest subnet group

2300

Number of addresses needed for
15% growth in the largest subnet
(Round up to the next whole number)

+ 345

Total number of address
needed for the largest subnet

= 2645

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Ft. Worth

148.55.0.0 to 148.55.15.255

IP address range for Dallas

148.55.16.0 to 148.55.31.255

IP address range for Router A
to Router B serial connection

148.55.32.0 to 148.55.47.255

IP address range for Router A
to Router C serial connection

148.55.48.0 to 148.55.63.255

IP address range for Router C
to Router D serial connection

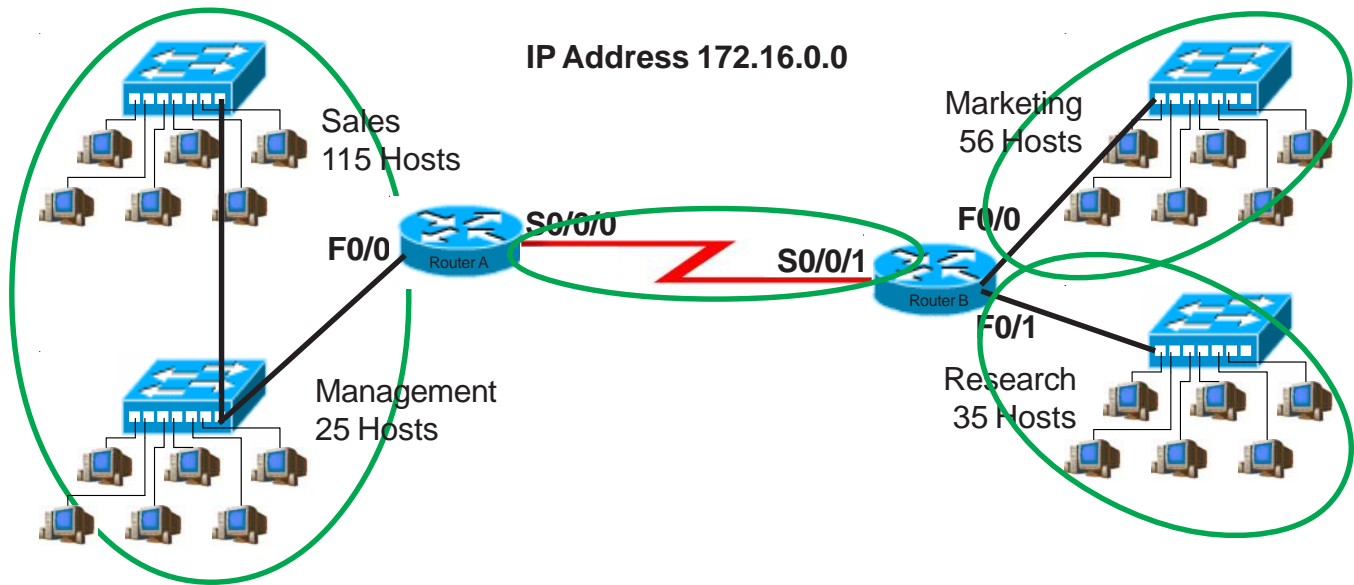
148.55.64.0 to 148.55.79.255

Show your work for Problem 9 in the space below.

| | | | | | | | | | | | | | | | | |
|---------------------|-----|----|----|----|----|----|-----|-----|-----|-------|-------|-------|-------|--------|--------|--------|
| Number of Hosts - | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1,024 | 2,048 | 4,096 | 8,192 | 16,384 | 32,768 | 65,536 |
| Number of Subnets - | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1,024 | 2,048 | 4,096 | 8,192 | 16,384 | 32,768 |
| Binary values - | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | | | | | | | | |
| 148.55.0.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| (1) | . | | | | | | | | | | | | | | | |
| (2) | | | | | | | | | | | | | | | | |
| (3) | | | | | | | | | | | | | | | | |
| (4) | | | | | | | | | | | | | | | | |
| (5) | | | | | | | | | | | | | | | | |
| (6) | | | | | | | | | | | | | | | | |
| (7) | | | | | | | | | | | | | | | | |
| (8) | | | | | | | | | | | | | | | | |
| (9) | | | | | | | | | | | | | | | | |
| (10) | | | | | | | | | | | | | | | | |
| (11) | | | | | | | | | | | | | | | | |
| (12) | | | | | | | | | | | | | | | | |
| (13) | | | | | | | | | | | | | | | | |
| (14) | | | | | | | | | | | | | | | | |
| (15) | | | | | | | | | | | | | | | | |
| (16) | | | | | | | | | | | | | | | | |

Practical Subnetting 10

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of subnets**, and allow enough extra subnets and hosts for 110% growth in all areas. Circle each subnet on the graphic and answer the questions below.



| | |
|------------------------------------------------------------------------------------------------------------|------------------------|
| Address class | <u>B</u> |
| Custom subnet mask | <u>255.255.255.240</u> |
| Minimum number of subnets needed | <u>4</u> |
| Extra subnets required for 110% growth (Round up to the next whole number) | <u>+ 5</u> |
| Total number of subnets needed | <u>= 9</u> |
| Number of host addresses in the largest subnet group | <u>140</u> |
| Number of addresses needed for 110% growth in the largest subnet (Round up to the next whole number) | <u>+ 154</u> |
| Total number of address needed for the largest subnet | <u>= 294</u> |

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

| | |
|----------------------------------------------------------------|-------------------------------------|
| IP address range for Sales/Management | <u>172.16.0.0 to 172.16.15.255</u> |
| IP address range for Marketing | <u>172.16.16.0 to 172.16.31.255</u> |
| IP address range for Research | <u>172.16.32.0 to 172.16.47.255</u> |
| IP address range for Router A to Router B serial connection | <u>172.16.48.0 to 172.16.63.255</u> |

Show your work for Problem 10 in the space below.

| Number of Hosts - | 8,192 | 16,384 | 32,768 | 65,536 | 256 | 512 | 1,024 | 2,048 | 4,096 | 8,192 | 16,384 | 32,768 | 65,536 |
|---------------------|------------|---------|---------|---------|---------|---------|---------|---------|--------------|---------|----------------|---------|---------|
| Number of Subnets - | 16 | 8 | 4 | 2 | 1 | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 |
| Binary values - | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 | 256 | 512 | 1,024 | 2,048 | 4,096 |
| | 172.16.0.0 | 0.0.0.0 | 0.0.0.0 | 0.0.0.0 | 0.0.0.0 | 0.0.0.0 | 0.0.0.0 | 0.0.0.0 | 0.0.0.0 | 0.0.0.0 | 0.0.0.0 | 0.0.0.0 | 0.0.0.0 |
| (1) | 0 | | | | | | | | 172.16.0.0 | to | 172.16.15.255 | | |
| (2) | 1 | | | | | | | | 172.16.16.0 | to | 172.16.31.255 | | |
| (3) | | 1 | | | | | | | 172.16.32.0 | to | 172.16.47.255 | | |
| (4) | | 1 | 1 | | | | | | 172.16.48.0 | to | 172.16.63.255 | | |
| (5) | | 1 | 0 | 0 | | | | | 172.16.64.0 | to | 172.16.79.255 | | |
| (6) | | 1 | 0 | 1 | | | | | 172.16.80.0 | to | 172.16.95.255 | | |
| (7) | | 1 | 1 | 0 | | | | | 172.16.96.0 | to | 172.16.111.255 | | |
| (8) | | 1 | 1 | 1 | | | | | 172.16.112.0 | to | 172.16.127.255 | | |
| (9) | 1 | 0 | 0 | 0 | | | | | 172.16.128.0 | to | 172.16.143.255 | | |
| (10) | 1 | 0 | 0 | 1 | | | | | 172.16.144.0 | to | 172.16.159.255 | | |
| (11) | 1 | 0 | 1 | 0 | | | | | 172.16.160.0 | to | 172.16.175.255 | | |
| (12) | 1 | 0 | 1 | 1 | | | | | 172.16.176.0 | to | 172.16.191.255 | | |
| (13) | 1 | 1 | 0 | 0 | | | | | 172.16.192.0 | to | 172.16.207.255 | | |
| (14) | 1 | 1 | 0 | 1 | | | | | 172.16.208.0 | to | 172.16.223.255 | | |
| (15) | 1 | 1 | 1 | 0 | | | | | 172.16.224.0 | to | 172.16.239.255 | | |
| (16) | 1 | 1 | 1 | 1 | | | | | 172.16.240.0 | to | 172.16.255.255 | | |

Valid and Non-Valid IP Addresses

Using the material in this workbook identify which of the addresses below are correct and usable. If they are not usable addresses explain why.

IP Address: 0.230.190.192

Subnet Mask: 255.0.0.0

Reference Page Inside Front Cover

The network ID cannot be 0.

IP Address: 192.10.10.1

Subnet Mask: 255.255.255.0

Reference Pages 28-29

OK

IP Address: 245.150.190.10

Subnet Mask: 255.255.255.0

Reference Page Inside Front Cover

245 is reserved for experimental use.

IP Address: 135.70.191.255

Subnet Mask: 255.255.254.0

Reference Pages 48-49

This is the broadcast address for this range.

IP Address: 127.100.100.10

Subnet Mask: 255.0.0.0

Reference Pages Inside Front Cover

127 is reserved for loopback testing.

IP Address: 93.0.128.1

Subnet Mask: 255.255.224.0

Reference Pages 56-57

OK

IP Address: 200.10.10.128

Subnet Mask: 255.255.255.224

Reference Pages 54-55

This is the subnet address for the 3rd usable range of 200.10.10.0

IP Address: 165.100.255.189

Subnet Mask: 255.255.255.192

Reference Pages 30-31

OK

IP Address: 190.35.0.10

Subnet Mask: 255.255.255.192

Reference Pages 34-35

This address is taken from the first range for this subnet which is invalid.

IP Address: 218.35.50.195

Subnet Mask: 255.255.0.0

Reference Page Inside Front Cover

This has a class B subnet mask.

IP Address: 200.10.10.175 /22

Reference Pages 54-55 and/or Inside Front Cover

A class C address must use a minimum of 24 bits.

IP Address: 135.70.255.255

Subnet Mask: 255.255.224.0

Reference Pages 48-49

This is a broadcast address.

IP Address Breakdown

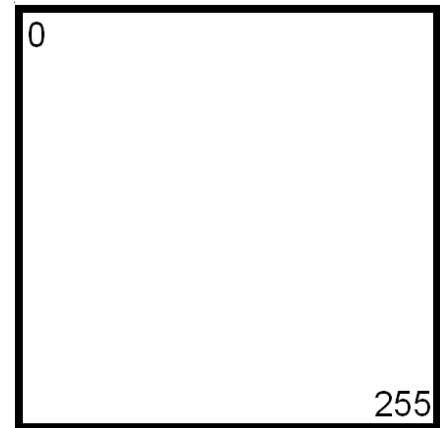
| /24 | /25 | /26 | /27 | /28 | /29 | /30 | | | |
|-------------------------------------|-----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|---------------------------------------|---------------------------------------|----------------|--------------------|------------------------------------------|
| 8+8+8 255.255.255.0 256 Hosts | 8+8+8+1 255.255.255.128 128 Hosts | 8+8+8+2 255.255.255.192 64 Hosts | 8+8+8+3 255.255.255.224 32 Hosts | 8+8+8+4 255.255.255.240 16 Hosts | 8+8+8+5 255.255.255.248 8 Hosts | 8+8+8+6 255.255.255.252 4 Hosts | | | |
| 0-255 | 0-127 | 0-63 | | 0-15 | 0-7 | 0-3 4-7 | | | |
| | | | | | 8-15 | 8-11 12-15 | | | |
| | | | | | | 16-31 | 16-23 20-23 | | |
| | | | | | | | 24-31 | 24-27 28-31 | |
| | | | | 32-47 | | | | 32-39 36-39 | |
| | | | | | 40-47 | | | 40-43 44-47 | |
| | | | | | | 48-63 | | 48-51 52-55 | |
| | | | | | | | 56-63 | 56-59 60-63 | |
| | | | 64-127 | | | | | 64-79 | 64-71 72-79 |
| | | | | | 80-95 | | | | 80-87 88-95 |
| | | | | | | 96-111 | | | 96-103 104-111 |
| | | | | | | | 112-127 | | 112-119 120-127 |
| | | | | 128-143 | | | | | 128-135 136-143 |
| | | | | | 144-159 | | | | 144-151 152-159 |
| | | | | | | 160-175 | | | 16-167 168-175 |
| | | | | | | | 176-191 | | 176-183 184-191 |
| | | 192-207 | | | | | | 192-199 200-207 | 192-195 196-199 200-203 204-207 |
| | | | | | 208-223 | | | 208-215 216-223 | 208-211 212-215 216-219 220-223 |
| | | | | | | 224-239 | | 224-231 232-239 | 224-227 228-231 232-235 236-239 |
| | | | | | | | 240-255 | 240-247 248-255 | 240-243 244-247 248-251 252-255 |

Visualizing Subnets Using The Box Method

The box method is the simplest way to visualize the breakdown of subnets and addresses into smaller sizes.

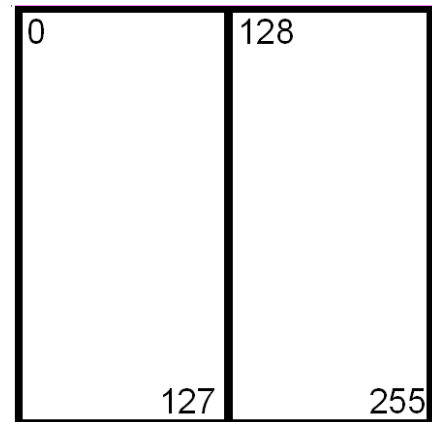
Start with a square. The whole square is a single subnet comprised of 256 addresses.

/24
255.255.255.0
256 Hosts
1 Subnet



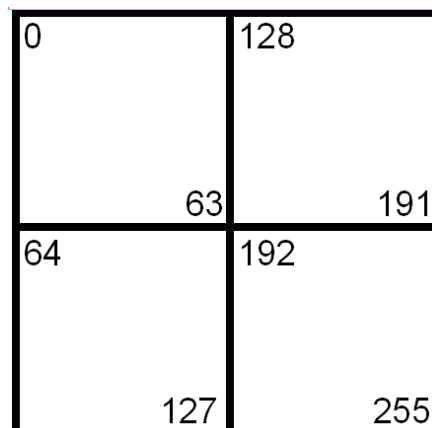
Split the box in half and you get two subnets with 128 addresses,

/25
255.255.255.128
128 Hosts
2 Subnets



Divide the box into quarters and you get four subnets with 64 addresses,

/26
255.255.255.192
64 Hosts
4 Subnets



Split each individual square and you
get eight subnets with 32 addresses,

/27
255.255.255.224
32 Hosts
8 Subnets

| | | | |
|----|----|-----|-----|
| 0 | 32 | 128 | 160 |
| | 31 | 63 | 159 |
| 64 | 96 | 192 | 224 |
| | 95 | 127 | 255 |

Split the boxes in half again and you
get sixteen subnets with sixteen
addresses,

/28
255.255.255.240
16 Hosts
16 Subnets

| | | | |
|----|-----|-----|-----|
| 0 | 32 | 128 | 160 |
| | 15 | 47 | 143 |
| 16 | 48 | 144 | 176 |
| | 31 | 63 | 159 |
| 64 | 96 | 192 | 224 |
| | 79 | 111 | 207 |
| 80 | 112 | 208 | 240 |
| | 95 | 127 | 255 |

The next split gives you thirty two
subnets with eight addresses,

/29
255.255.255.248
8 Hosts
32 Subnets

| | | | | | | | |
|----|----|-----|-----|-----|-----|-----|-----|
| 0 | 8 | 32 | 40 | 128 | 136 | 160 | 168 |
| | 7 | 15 | 39 | 47 | 135 | 143 | 175 |
| 16 | 24 | 48 | 56 | 144 | 152 | 176 | 184 |
| | 23 | 31 | 55 | 63 | 151 | 159 | 183 |
| 64 | 72 | 96 | 104 | 192 | 200 | 224 | 232 |
| | 71 | 79 | 103 | 111 | 199 | 207 | 239 |
| 80 | 88 | 112 | 120 | 208 | 216 | 240 | 248 |
| | 87 | 95 | 119 | 127 | 215 | 223 | 255 |

The last split gives sixty four subnets
with four addresses each,

/30
255.255.255.252
4 Hosts
64 Subnets

| | | | | | | | |
|----|----|-----|-----|-----|-----|-----|-----|
| 0 | 8 | 32 | 40 | 128 | 136 | 160 | 168 |
| | 3 | 11 | 35 | 43 | 131 | 139 | 171 |
| 4 | 12 | 36 | 44 | 132 | 140 | 164 | 172 |
| | 7 | 15 | 39 | 47 | 135 | 143 | 175 |
| 16 | 24 | 48 | 56 | 144 | 152 | 176 | 184 |
| | 19 | 27 | 51 | 59 | 147 | 155 | 179 |
| 20 | 28 | 52 | 60 | 148 | 156 | 180 | 188 |
| | 23 | 31 | 55 | 63 | 151 | 159 | 183 |
| 64 | 72 | 96 | 104 | 192 | 200 | 224 | 232 |
| | 67 | 75 | 99 | 107 | 195 | 203 | 235 |
| 68 | 76 | 100 | 108 | 196 | 204 | 228 | 236 |
| | 71 | 79 | 103 | 111 | 199 | 207 | 239 |
| 80 | 88 | 112 | 120 | 208 | 216 | 240 | 248 |
| | 83 | 91 | 115 | 123 | 211 | 219 | 243 |
| 84 | 92 | 116 | 124 | 212 | 220 | 244 | 252 |
| | 87 | 95 | 119 | 127 | 215 | 223 | 255 |

Class A Addressing Guide

| CIDR | # of Bits Borrowed | Subnet Mask | Total # of Subnets | Total # of Hosts | Usable # of Hosts |
|------|--------------------|-----------------|--------------------|------------------|-------------------|
| /8 | 0 | 255.0.0.0 | 1 | 16,777,216 | 16,777,214 |
| /9 | 1 | 255.128.0.0 | 2 | 8,388,608 | 8,388,606 |
| /10 | 2 | 255.192.0.0 | 4 | 4,194,304 | 4,194,302 |
| /11 | 3 | 255.224.0.0 | 8 | 2,097,152 | 2,097,150 |
| /12 | 4 | 255.240.0.0 | 16 | 1,048,576 | 1,048,574 |
| /13 | 5 | 255.248.0.0 | 32 | 524,288 | 524,286 |
| /14 | 6 | 255.252.0.0 | 64 | 262,144 | 262,142 |
| /15 | 7 | 255.254.0.0 | 128 | 131,072 | 131,070 |
| /16 | 8 | 255.255.0.0 | 256 | 65,536 | 65,534 |
| /17 | 9 | 255.255.128.0 | 512 | 32,768 | 32,766 |
| /18 | 10 | 255.255.192.0 | 1,024 | 16,384 | 16,382 |
| /19 | 11 | 255.255.224.0 | 2,048 | 8,192 | 8,190 |
| /20 | 12 | 255.255.240.0 | 4,096 | 4,096 | 4,094 |
| /21 | 13 | 255.255.248.0 | 8,192 | 2,048 | 2,046 |
| /22 | 14 | 255.255.252.0 | 16,384 | 1,024 | 1,022 |
| /23 | 15 | 255.255.254.0 | 32,768 | 512 | 510 |
| /24 | 16 | 255.255.255.0 | 65,536 | 256 | 254 |
| /25 | 17 | 255.255.255.128 | 131,072 | 128 | 126 |
| /26 | 18 | 255.255.255.192 | 262,144 | 64 | 62 |
| /27 | 19 | 255.255.255.224 | 524,288 | 32 | 30 |
| /28 | 20 | 255.255.255.240 | 1,048,576 | 16 | 14 |
| /29 | 21 | 255.255.255.248 | 2,097,152 | 8 | 6 |
| /30 | 22 | 255.255.255.252 | 4,194,304 | 4 | 2 |

Class B Addressing Guide

| CIDR | # of Bits Borrowed | Subnet Mask | Total # of Subnets | Total # of Hosts | Usable # of Hosts |
|------|--------------------|-----------------|--------------------|------------------|-------------------|
| /16 | 0 | 255.255.0.0 | 1 | 65,536 | 65,534 |
| /17 | 1 | 255.255.128.0 | 2 | 32,768 | 32,766 |
| /18 | 2 | 255.255.192.0 | 4 | 16,384 | 16,382 |
| /19 | 3 | 255.255.224.0 | 8 | 8,192 | 8,190 |
| /20 | 4 | 255.255.240.0 | 16 | 4,096 | 4,094 |
| /21 | 5 | 255.255.248.0 | 32 | 2,048 | 2,046 |
| /22 | 6 | 255.255.252.0 | 64 | 1,024 | 1,022 |
| /23 | 7 | 255.255.254.0 | 128 | 512 | 510 |
| /24 | 8 | 255.255.255.0 | 256 | 256 | 254 |
| /25 | 9 | 255.255.255.128 | 512 | 128 | 126 |
| /26 | 10 | 255.255.255.192 | 1,024 | 64 | 62 |
| /27 | 11 | 255.255.255.224 | 2,048 | 32 | 30 |
| /28 | 12 | 255.255.255.240 | 4,096 | 16 | 14 |
| /29 | 13 | 255.255.255.248 | 8,192 | 8 | 6 |
| /30 | 14 | 255.255.255.252 | 16,384 | 4 | 2 |

Class C Addressing Guide

| CIDR | # of Bits Borrowed | Subnet Mask | Total # of Subnets | Total # of Hosts | Usable # of Hosts |
|------|--------------------|-----------------|--------------------|------------------|-------------------|
| /24 | 0 | 255.255.255.0 | 1 | 256 | 254 |
| /25 | 1 | 255.255.255.128 | 2 | 128 | 126 |
| /26 | 2 | 255.255.255.192 | 4 | 64 | 62 |
| /27 | 3 | 255.255.255.224 | 8 | 32 | 30 |
| /28 | 4 | 255.255.255.240 | 16 | 16 | 14 |
| /29 | 5 | 255.255.255.248 | 32 | 8 | 6 |
| /30 | 6 | 255.255.255.252 | 64 | 4 | 2 |

